STAFF WORKSHOP

BEFORE THE

CALIFORNIA ENERGY RESOURCES CONSERVATION

AND DEVELOPMENT COMMISSION

In the Matter of:)
)
Building Energy Efficiency)
Standards for Residential and)
Nonresidential Buildings)
)

CALIFORNIA ENERGY COMMISSION

1516 NINTH STREET

HEARING ROOM A

SACRAMENTO, CALIFORNIA

TUESDAY, APRIL 23, 2002

10:00 A. M.

Reported by:
Peter Petty
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CEC STAFF PRESENT

Bryan Alcorn, Workshop Chair, Energy Efficiency Division

Arthur H. Rosenfeld, Commissioner

Bill Pennington, Energy Efficiency Division

Gary Klein, Energy Technology Development

Elaine Hebert, Energy Efficiency Division

Mazi Shirakh, Mechanical Engineer, Energy Efficiency Division

CEC CONTRACTORS

Charles Eley, FAIA, PE, Eley Associates

Bruce A. Wilcox, PE, President, Berkeley Solar Group

Marc Hoeschele, PE, Senior Engineer, Davis Energy Group, Inc.

David A. Springer, Vice President, Davis Energy Group, Inc.

Rick Chitwood, Chitwood Energy Management

Mark Hydeman, PE, Principal, Taylor Engineering

James Benya, Benya Lighting Design

MEMBERS OF THE PUBLIC

Robert E. Raymer, PE, Technical Director/Senior Advocate, California Building Industry Association

Bill Mattinson, Sol-Data Energy Consulting

Steve Gates, Hirsch & Associates

Robert W. Hammon, PhD, Principal, ConSol

MEMBERS OF THE PUBLIC (continued)

Noah Horowitz, Senior Scientist, Natural Resources Defense Council

Douglas Mahone, Partner, Heschong Mahone Group

Nehemiah Stone, Senior Project Manager, Heschong Mahone Group

Jeff Chapman, California Living & Energy

Ken Nittler, PE, Enercomp, Inc.

Ed Stahl, General Contractor, Sunworks Construction & Structural Insulated Panel Association

Douglas A. Vezina, Area Sales Manager, Owens Corning, Thermal & Acoustical Insulation Systems

Misti Bruceri, Program Manager, Custom Energy Management, Pacific Gas and Electric Company

Thomas L. Trimberger, PE, Senior Mechanical Engineer, County of Sacramento, Department of Public Works, Building Inspection Division

Larry K. Acker, Advanced Conservation Technology, Inc., Metlund D'Mand Systems

A. Y. Ahmed, Southern California Gas Company

Tony Pierce, Southern California Edison

Steve Blanc, Pacific Gas and Electric Company

Gary Fernstrom, Pacific Gas & Electric

Gary Farber, CABEC

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P R O C E E D I N G S

10:08 a.m.

WORKSHOP CHAIR ALCORN: Thank you all for coming this morning. My name is Bryan Alcorn. I'm the contract manager for this round of the building standards. I'm responsible for the administration of the contract.

To my right is Bill Pennington, and Bill is responsible for the technical development of the contract. And to his right is Charles Eley, who is the prime contractor for this work.

On January 18th of this year, the energy policy committee selected or identified 28 topics for consideration in the 2005 standards. And today, the purpose of the workshop is to discuss six of those topics. Three of them are residential and the remaining three are non-residential.

I would like to also welcome the Commissioner's office to the workshop this morning, Commissioner Rosenfeld to my left. And I'm not sure if Commissioner Pernell is going to join us. I think so maybe later; if not, hopefully he's listening in on the squawkbox.

COMMISSIONER ROSENFELD: Oh, I'm sure

he is.

WORKSHOP CHAIR ALCORN: So I wanted to just go over a couple of housekeeping items regarding speaking. If you're going to make comments today, if you could please make them into the microphone and before you do make your comments identify yourself for the recorder. The recorder is sitting across the table, next to Bob Raymer. If you're out in the audience and you would like to make a comment, if you could please approach the lectern and identify yourself and make your comments, that would be great.

So, with that, I would like to invite opening comments from either Bill Pennington or Commissioner Rosenfeld.

CEC STAFF PENNINGTON: I second Art's comments.

COMMISSIONER ROSENFELD: Welcome.

CEC STAFF PENNINGTON: Yes, there you go. It should be interesting. Thanks for coming.

WORKSHOP CHAIR ALCORN: Okay.

CONTRACTOR WILCOX: I'm Bruce Wilcox and I'm the lead person on the residential or most of the residential topics. And this morning we're going to talk about construction quality and the situation with wall insulation, and proposed changes in the treatment of wall insulation in the standards.

The situation on the wall insulation currently is that the compliance rules that are in place for people complying with the standards don't really reflect the industry standard practice in the field. And we're talking here compliance rules that primarily govern how you calculate the U factors in for walls.

Remember that California, in California most compliance is done using performance approaches, where the actual U factor of the wall is what's critical. And what the current research has shown is that there are two essential problems with the current compliance rules.

The first of those is the framing factors, which is the assumption that's made about how many studs there are in the wall and what fraction of the wall is occupied by solid framing, is not realistic. It's way too optimistic.

The second thing is that the installation is also optimistic. We assume essentially that insulation is perfectly installed in the cavities in the wall. And we're going to talk about some research that shows that that, in typical standard construction, is not the case.

Our proposal is that we make a budget neutral correction for each of those factors in the 2005 rules for wall insulation. Budget neutral in this sense means that we propose that both the proposed house and the reference house both be based on realistic framing factors and insulation defects, so that if someone is doing simple straightforward compliance, you build a wall the same way you build it now, it still complies the same way it does now.

It's just that we treat the characteristics of those walls in a more realistic fashion. So it's a technical correction with no short-term compliance implications.

I'm going to summarize the proposed changes and then I'm going to turn this over to Rick Chitwood and Marc Hoeschele, who are going to talk about the actual analysis and so forth. But just so you know what we're talking about here, we're proposing to change the framing factors, which is the assumption about how much solid framing is in the wall, from 15 percent to 26 percent, which gives a much more -- we think a much more realistic and technically solid analysis of the wall situation.

And then we're proposing to change the R factors of batt insulation to reduce the effectiveness of the batt by multiplying the R factor by a 0.69 multiplier.

CBIA REP RAYMER: Is that because of installation concerns, or --

CONTRACTOR WILCOX: Yes. This is due to -- You'll see in a minute. We're going to talk about where this came from and what the details were.

So the results of that are increased U factors. If you have a two-by-four on a 13 wall with no foam sheeting, the U factor for that would go up 37 percent. With a foam sheeting on the outside, the U factor goes up less, but it still goes up 27 percent. These are significant changes in the assumed performance of those walls, for sure, but again, we're talking about this being applied to both the standard design reference house and the proposed house. So it doesn't have an immediate calculation impact on compliance.

What it does do, though, is it opens the possibility of getting credit for better installation and credit for better systems in the future. And that's the important thing we're actually doing by establishing this.

Okay. I'd like to turn this over now to Marc Hoeschle from Davis Energy Group, who will talk about the analysis that's behind this proposal.

CONTRACTOR HOESCHELE: Thank you. To give you a little background on what's been going on in walls, Oakridge National Labs that has been doing a lot of work over the past ten or more years, doing laboratory hot-box testing of different wall assemblies and wall constructions, and what they're doing is testing eight-foot by eight-foot wall assemblies in a whole range of configurations.

And recently they've done more testing to try and get at real world performance of these walls by incorporating plumbing and wiring and other defects that are common, rounded shoulders and voids in the cavity where there is no insulation. There have been numerous reports printed on this, and documenting where a two-by-six R-19 wall performs close to an R-11. So there is a lot of research coming out of Oakridge testifying to this effect.

With the Energy Commission, we've been working as the prime contractor for the last three years on the residential construction quality project, which is going into new homes in California and doing a range of diagnostic tests. We've tested 60 homes over the past three years, Rick Chitwood has been doing the testing.

And in two phases: the first phase our attempt was to look at exterior wall performance using an infrared camera by heating the house up the night before the testing, and hoping that we had a good Delta T the next morning to be able to use the infrared camera to distinguish performing cavities versus non-performing, and to use that as a quantification tool. We didn't have very good success with that. California climate doesn't always cooperate as well as giving you the Delta T and other effects like that.

In phase two, which field work took place in the last six months, we looked at developing a methodology where essentially we would, before the drywall goes up on the insulated wall of a house, we would go in and do a complete survey of the exterior walls, calculating a UA for different sections of the wall, basically working your way all the around the house and calculating a UA.

The U value assumed, I'll show you a slide in a minute to show where that comes from, but the idea is to account for compression of the batts and missing insulation. So if a section of a cavity was uninsulated, the area would be calculated and a zero R value would be assigned to that. Other sections of the wall would have a degraded R value input and an associated area. And that defect could be due, again, to compression, poor insulation quality where the batts are buckled, shoulders are rounded or so forth. So by this process, we worked all the way around the house, and essentially calculated a whole-house UA. And that was then compared to our standard assumptions, what's currently assumed in Title 24.

The other component of degraded wall performance is the framing factor study, which was done by Enermodal and Chitwood Energy Management last year, I think, where houses in California, single-family among others, detached multi-family and so forth, were surveyed doing -- counting studs to come up with an accurate framing factor. And the results from that study are consistent with other data published by ASHRAE on national results.

So in the residential construction quality project, we found ten homes where we did the insulation inspections in detail. And of those ten, five were characterized as industry standard installations, and five were high-quality. Four of the five high-quality ones were situations where the builder was paying the insulator more to do, in essence to do the job right. So they were paying a premium to have the batts installed properly, the batts cut so that there is no compression behind wiring and plumbing.

And the fifth of the final high-quality site was a cellulose spray-applied wall where visually inspecting that, there were no observed defects. So the cavities were full with insulation, and flush with the drywall that would ultimately be installed.

So the results from this analysis, calculating an overall UA, incorporating the defects and comparing that to what the framing factor adjustment does alone, increases the U value, the average U value for these five houses, industry standard houses by 20 percent.

Looking at the high-quality houses where the insulation was installed better, the total increase in U value, over -- just accounting for the framing factor, was only three percent. And again, the spray-applied cellulose had no visual defects, so there was no degradation beyond the framing factor adjustment.

This graph basically takes, this is how compression information was converted into effective cavity R value for the defects. And on the Y axis, the vertical axis, we have percent of nominal R value, in going from zero to 100. On the X axis, we have percent of bad compression from nominal thickness, again going from zero to 100.

Up in the upper left, there are three points which are taken from the Energy Commission's residential manual, which is manufacturers' data on the impact of compression on nominal R value. So those essentially take an R-19 batt, and if you put it in a two-by-six cavity you get, I think, R-17.8 out of that. So it reflects that kind of data.

We extrapolated those three points to the extreme case, where the batt is 100-percent compressed and, therefore, has no R values. So that's the point down on the lower right.

So this curve, then, is how compressed sections were handled in our visual takeoff. Voids would be assigned a zero R value, compressed sections would be assigned an R value, based on this correction to the nominal R value.

COMMISSIONER ROSENFELD: You actually must mean voids are assumed like an R value of one, not zero, right? I mean, they're still an airfill?

CONTRACTOR HOESCHELE: Well, no. See, all we were looking at --

COMMISSIONER ROSENFELD: Oh, you added an airfill.

CONTRACTOR HOESCHELE: We're building that in, yeah. So we were just looking at the cavity between the -- Correct.

Okay, and the final, the next slide then summarizes what Bruce first presented. It's basically the two slides showing what an unsheathed wall, without exterior rigid insulation, how it performs under these different assumptions. On the left we're beginning with the current Title 24 assumption, where are R-13 wall has a .088 on the Y axis, again as U value; the X axis is five different cases. The first current, the second is accounting for the 26 percent framing factor. So that's just adding more wood into the wall, which degrades the overall performance.

The third is the spray-applied cellulose, where we're assuming no degradation beyond the framing factor. The fourth is a nominal insulated wall, and there we have a 69-percent of nominal cavity R value, as well as a framing factor adjustment. And then the fifth is our quality installation case, which has a minor degradation beyond the framing factor adjustment. The next slide shows the same thing for a sheathed wall with R-4 exterior, R-13. So the U values are lower and the impact is smaller because of the sheathing, but it shows a similar trend.

Now, what we're proposing is that this, for the next round of standards, that cavity R values for nominal insulated walls get degraded to 69 percent of nominal, and that a credit is in place for both a high-quality installation and for spray-applied cellulose. Both of the latter two would require some level of HERS inspection as verification. And a checklist would need to be developed in training for the HERS raters to do this.

We would strongly recommend a sampling approach for this, because it is very cumbersome to time it right with the wall insulation and then the drywall typically happens the next day. So there has to be a fair amount of flexibility in obtaining this credit with, you know, making it reasonable on the builder to meet this.

Now, Rick Chitwood will speak next about more of the details of what he saw in both the framing factor work he did, and also the actual insulation inspections.

CONTRACTOR CHITWOOD: So I performed most of the field inspections as part of the RQA work. And a few general industry trends that we spotted, barriers first provided by the construction industry that impacted the ability of the insulation contractors to do a high-performance job.

The first thing we saw was an ever-increasing architectural complexity. These aren't the houses we saw 30 years ago that had eight-foot flat ceilings and were a perfect rectangle. We're seeing constantly more and more architectural complexity. We're seeing master bathrooms with three little one-foot-square windows that require a tremendous amount of framing that the insulators have to work around. We even saw some CC&Rs that required that no wall could be longer than 20 feet long for architectural reasons. So we're seeing more corners, more framing.

Also in recent years, of course, structural requirements have been upgraded and seismic calculations, so we're seeing more framing also for seismic and structural reasons. We're also seeing more obstacles in the stud cavities -- the new data wire systems, audiovisual security systems, home automation -- and then normal obstacles like electrical panels, phone panels, medicine cabinets. All those provide barriers in cavities that prevent the insulation contractors from installing insulation properly.

Last week my company insulated a house and the subcontractor that installed all of the security system said that there was 30,000 feet of low-voltage and TV wire in the house, over six miles of wire, with the home theater. And it was a big 3,000-square-foot house. But that's how much wire he said he put in that house.

And, as normal in the construction industry, we see constant price pressure for insulation contractors to keep their prices low, and probably their training budgets are low because of that.

For wall insulation to perform properly, we need to start with an airtight cavity. Secondly, we need the fiberglass batt or whatever the insulation is, to be completely lofted and completely fill the cavity, and be in contact with the air barrier on both sides. Additionally, no gaps or voids and no areas of compression. So those are the goals when we assess, when we want wall insulation to perform properly.

This is one of my favorite pictures, and this isn't wall insulation, it's a little cantilevered floor insulation section. In this case, the builder actually had the insulation subcontractor come to the site early and preinsulate the house, and do little areas like this that would not be accessible after the lath was installed.

So the insulation contractor made a special trip out to install insulation that, because of its method of installation, performs at R-0. There is so much air movement around all of these batts and there is no contact with an air barrier on either side, so this is actually a complete waste of energy and that's the energy to manufacture the batts and install them, if they perform at zero.

So it kind of reflects training levels and attitudes in that there is not a lot of demand on the insulation to actually be installed so it performs well. So even though the builder in this case made sure it was preinsulated, the building inspector, the superintendent, the installer didn't get it installed so that it would perform at all.

This is another barrier to insulation performance, and goes back to architectural complexity. This is a turret on the front of a house with 12-inch-thick walls, one window and one other architectural feature. It made it almost impossible for an insulation subcontractor to insulate so that the insulation could perform at even near its rated-R value.

Air sealing and air movement through walls, this was a case where so much air moved under the bottom plate that it brought dust into the house and left streaks of dust. I don't know if it will show very well in the slide, but even though caulking and sealing is always done by the insulation subcontractors, we often see it done in such a manner that it doesn't perform well.

This is just a case -- I don't know if this will help. Here is an area where the batt is completely missing. This is a void here and here.

Maybe we could reduce lighting levels in the room? I don't know if that will help.

Thank you.

So, of course the missing batt performs at R-0. You know, this batt with shoulders, voids, especially voids at the top of the cavity performs at a much reduced R value.

Such a common situation with excess blocking in the wall -- I don't recall the reason for all the extra blocking, whether that was an exterior channel. Electrical wiring, small cavities, nothing. In a lot of houses we probably see less than five percent of the stud cavities are actual nominal 16-inch cavity.

It's such a joy when you're insulating a house to come along and actually see a cavity that is the right width and the bat doesn't have to be cut for some reason. So here, because of the wiring and the compression, the installers just pieced in a bunch of pieces there to fill the cavity.

Another problem is when we see balloon-framed walls -- This is a 20-foot-tall balloon-framed wall framed at 12 inches on center and with two-by-sixes, and the installer just slit insulation but yet only put R-13 or nominal four-inch-thick insulation in this six-inch-thick wall, so we end up with at least two inches of air space, some on the front and some on the back, which in these ten-foot wall sections can create tremendous convective current loops.

CBIA REP RAYMER: Do you know why they did 12-inch on center there?

CONTRACTOR CHITWOOD: I believe it was structural. Then they get a stud under every truss and keep the wall straight.

This is an industry trade standard

practice, to not put the fiberglass batts as it should be, which would be half behind and half in front of the electrical wiring. So in the first two bays there on the right, the installer has elected to put the batt 100 percent behind the wire, and then on the bay on the left, he put the batt 100 percent in front of the wire. So we end up with pretty much half a bay that's air space.

This is an infrared slide of an electrical outlet and the electrical wire running off to the left. It's fairly easy to see the insulation deterioration and the areas that aren't performing well. In the center of the batts, we can see where the insulation is actually touching the drywall, and the wall is much warmer. And then the red area is part of a degree cooler, and that's the area where the insulation isn't touching the drywall. And then the electrical outlet and the wire running off to the left. And, of course, we see significant performance deterioration.

This is a case where there was a lot of wiring in the wall, and the installer put the insulation 100 percent on top of the wiring, so it looked good on the surface, but yet there was a significant inch to two-inch void behind the insulation. What is a little sad in this case is that the builder was paying for our very best product. This is R-15 fiberglass batt insulation, so we're supposed to be able to get a nominal R-15 out of this product, which is much more expensive than R-13, maybe as much as 80 to 100 percent more expensive to purchase the material, but yet installation defects, properly installed R-13 probably would have been a better investment here.

These are common nine-foot walls, but we aren't seeing any material being manufactured in nine-foot and ten-foot lengths. We still typically get eight-foot material is what we see. So here they've put a one-foot batt at the bottom, and actually what they did was the one-foot extra fill-in piece was too long, so the batts overlap each other and there is a void below the top batt and above the lower batt.

This is a wall channel, a narrow cavity where there is an interior wall intersection, and this is in the garage. So here they had an opportunity to do a wall channel but neglected to put the batt in. And we also see fairly normal amounts of compression buckling and the batt not being lofted. And, of course, this is a thick wall, it's been firred another three-eighths of an inch.

This is an interior wall channel where the wiring coming into the interior wall wasn't foamed and sealed, but we can also see that there was no insulation in the cavity, in the channel cavity. So this is the type of cavity that would normally get insulation when the builder asks the insulation contractor to come out and preinsulate the house, do the exterior, inaccessible channels before the lath was installed.

This is a real simple-to-diagnosis missing section of batt in an exterior wall with infrared.

Here is just kind of a little bit of everything. We can see in this corner we have a narrow cavity that doesn't have any insulation in it at all, and we see part of a cavity here with no insulation. We see a real narrow cavity here with highly compressed insulation in it, and then probably an inch and a half or two-inch void.

We see cavities that weren't cut to the right width. This cavity is probably three inches wider than the stud cavity, so the only way it goes in is to buckle, so we create voids here and compressions were behind the void. So in this one slid we see almost every installation issue imaginable.

Here is more just common voids. Of course, some of the worst voids are the voids that we see at the top of the batt, in that that makes it easier for convective current to get started. This next bay, the batt -- the small piece is too big and it's buckled.

This is a bent pipe going through the top plate. So here at the top plate there is no caulking or sealing to prevent air movement, and of course, the insulation is compressed and buckled on both sides. And this batt here is much too wide.

In this slide we have both a drainpipe and hot and cold supply piping. You can see here the piping is only about an inch from the front of the stud, but in this bay the expensive R-15 batt was put 100 percent in front of the piping, so it was compressed clear down to an inch. And then, of course, in this bay they put it all behind, which is a little better because there was more room. And again, this is an installation job with

R-15, the most expensive product we have.

Here are big seismic hold-downs. These are big metal brackets that are bolted to the studs and have threaded rods below them, and there is extra framing here and this is at least two studs. And we have buckles in the narrow cavities and three studs there, so a tremendous amount of extra framing occurs when the structural engineer requires special hold-downs.

This is the highest-quality insulation, batt insulation job that we saw, and I regret the photo isn't a little better quality. These are ten-foot walls. As you look across this level, you can see how well they lined up the seam between batts and see very little -- here is some compression buckling, but very small amounts. And we see that most of the fiberglass is installed so it comes right to the base of the stud. We see, even though this wall has some plumbing for a refrigerator and lots of wiring -- it's a kitchen wall -- in it for kitchen plugs, we still see overall no significant defects.

With this type of installation, we actually calculated a nine-percent deterioration in value. Is that the right number, Marc?

CONTRACTOR HOESCHELE: Nine percent?

CONTRACTOR CHITWOOD: No, six percent, 94, right? Ninety-four. So we calculated that this wall would perform at 94 percent of its rated R value or U value.

On this slide this was the job where the builder actually paid 30 percent more to have this insulation installed. That was the upgrade charge with no change in specifications. It's still R-13 in the walls and R-38 in the seam.

And this is spray-applied cellulose. And in the two houses we looked at -- In fact, they were so similar we just counted them as one specimen -- we couldn't find any noticeable visual defects. Everything was perfect.

CEC STAFF PENNINGTON: I have a couple of questions, Rick. You are pretty much of a newcomer to this area, right? You haven't done much work like this, right? That's a joke.

(Laughter.)

CONTRACTOR CHITWOOD: And I was trying to figure out how I was going to address that one.

CEC STAFF PENNINGTON: Yeah. Can you maybe just describe what experience you've had with looking at installation jobs over your career, if you could do that quickly.

CONTRACTOR CHITWOOD: Actually, I've just been focused on insulation performance for the last ten years, and it started with a utility program when we ended up with an infrared camera. We've been mechanical contractors for about 24 years, but ten years ago when we saw how poorly thermal envelopes were performing, we instantly became insulation contractors and have been using the infrared camera ever since, to make sure that the insulation we installed, especially in the houses where we do the heating and cooling equipment, performs properly.

So I've been real focused on insulation performance for ten years now.

CEC STAFF PENNINGTON: Would you be able to guess how many insulation jobs you've seen, you've either been involved with you've observed?

CONTRACTOR CHITWOOD: Well, if we can exclude the ones my company does, probably 500 or so.

CEC STAFF PENNINGTON: Five hundred or so. Okay, thanks.

There was a relatively limited number

of houses that were evaluated through this detailed U value calculation approach, but I'm wondering if you could contrast what you saw in those houses to the other houses that were seen in the survey.

CONTRACTOR CHITWOOD: Right. These installation defects are typical. We see them in, you know, almost every house we look at, with the exception of two, and that's when we see a spray cellulose or a blown-in batt system, or we see the new environments for living, which has insulation inspections built into their program. And they have a zero tolerance for installation defects built right into it.

We have, as part of the RQA work, a videotape record of all of the rough-framed houses that we looked at. So, though we only did detailed takeoffs and accurately quantified the defects, we have videotape of another 40 houses, of showing the overall installation quality.

CEC STAFF PENNINGTON: And basically similar results you would -- except for the houses that were somehow targeted to --

CONTRACTOR CHITWOOD: And that's a fairly new phenomenon. I don't think we had --

well, we might have had two in the first days.

CEC STAFF PENNINGTON: Okay, thank you.

COMMISSIONER ROSENFELD: I have a question.

(Loud buzzing.)

CEC STAFF PENNINGTON: There's a caller or two that's going to come in, so --

CONTRACTOR CHITWOOD: It's a call-in show.

CEC STAFF PENNINGTON: Yeah, right.

COMMISSIONER ROSENFELD: It seems as if two-thirds or half of the panels you showed us should just, you should give up on batt insulation and go to foam insulation. Can you comment on that?

CONTRACTOR CHITWOOD: Well, we have other systems, and we didn't -- in our sample we didn't see any rough-framed blown-in blanket fiberglass systems, another system that's relatively immune to installation defects, as is the cellulose. So the blown-in systems are much more immune, as is foam, to installation defects.

COMMISSIONER ROSENFELD: I should have said foam, I guess, yeah.

CONTRACTOR CHITWOOD: That doesn't mean

at all that fiberglass can't be installed, so it performs very close to its rated R values.

For example, my company has the ability to do spray-applied cellulose, cellulose behind net, or fiberglass batts. We almost always do fiberglass batts. We find that to be the most cost-effective balance between installation cost and performance. But we do spend two or three times longer installing them than the typical installer.

COMMISSIONER ROSENFELD: Okay.

SPEAKER MATTINSON: I have just a quick question.

CONTRACTOR CHITWOOD: Sure, Bill.

SPEAKER MATTINSON: Isn't there, and I'm partly speaking from my own experience and partly in light of Dave Ware's letter -- I don't know if you've even seen that -- commenting on these things. But he did bring up the point that although sprayed in systems like cellulose may look good, you have to be aware of density and things like that, that you can't really inspect visually.

CONTRACTOR CHITWOOD: Yeah, there's two different things here, because I did work with

Dave on some density testing, and that was a blown-in blanket, fiberglass behind some sort of membrane. And it's very easy in that case to blow a lower density or almost none at all, and some of the fabrics are very hard to see through. So there are some density issues, and part of the requirement of the HERS inspection would be to assess the density of those type of systems.

With the spray-applied cellulose, it's difficult to not get the right density, and we probably don't know enough about that. But if it falls out of the cavity, the density probably wasn't right.

SPEAKER MATTINSON: Thanks.

SPEAKER GATES: Steve Gates with Hirsch and Associates. Two questions. Looking at the charts here, in terms of the various installed R values or U values of insulation, you know, one thing that really jumps out on this is if you install the four-inch sheeting, you know, the four-inch exterior insulation, it -- you know, even in the poorest quality installation it then does far better than the best installed job without the sheeting.

So the question is, and it really kind

of ties into an enforceability issue with, you know, if there's going to be credits given for quality installation, how do you really enforce that overall? I mean, does it really make sense to consider more going in that direction where you can cover up an awful lot of sins by simply having something to the exterior of everything.

That's the first question --

CONTRACTOR WILCOX: Is that a question?

(Laughter.)

SPEAKER GATES: -- and comment.

CEC STAFF PENNINGTON: What I think you're starting to get at, differentiating between products, basically saying you want this product or maybe a system, as Charles was pointing out, instead of saying any product or system that can meet your performance is satisfactory.

SPEAKER GATES: Yeah, and how do you enforce the quality? You know, that's really the -- and it's not a question as much as a comment, just in terms of enforceability and what all.

CEC STAFF PENNINGTON: Yeah.

SPEAKER GATES: The other question I'd like to ask was, with all the pictures I saw, I didn't observe a vapor barrier. Is that not required?

CONTRACTOR CHITWOOD: Only in the mountain climate zone predominantly is a vapor barrier required.

SPEAKER GATES: I see, okay.

CBIA REP RAYMER: This is Bob Raymer, CBI. You were talking about an R-4 sheeting, not a four-inch sheeting.

SPEAKER GATES: Did I say four-inch?

CBIA REP RAYMER: Yeah.

SPEAKER GATES: I meant R-4. No, it was a direct comment on what was presented in the slides, where they have an R-4 exterior sheeting on it.

CEC STAFF PENNINGTON: Could I ask a question of Rob? You've done a lot of field work, you've been out looking at new homes, and you've been trying to pay attention to installation, quality of insulation.

What is your experience relative to what you saw presented here?

SPEAKER HAMMON: Rob Hammon, ConSol. Conceptually I have no arguments, or let me put that in a positive sense. Conceptually I agree with what Rick has found, that there are problems in the field with the quality of the installations.

We have taken a similar approach to Rick, that we aren't installers, but we do have raters who go out and inspect the quality of the job. We worked with the Commission and some other folks some years ago to come up with installation guidelines that form a part of our program, and the installers are required to build to those requirements.

We assume that there is a substantial energy impact from installing the batts correctly. We don't see blown-in cellulose because it costs about twice as much as batts, so the builders don't go there. I don't have personal experience with blown-in cellulose, other than having seen it, and so I don't really know what the potential issues are. It concerns me a little bit, more than a little bit I guess, that we're trying to differentiate between the optimum quality installed batts and the blown-in insulation.

Because I don't think we know terribly well what the sort of hidden side of the cellulose looks like. But regardless, I'm not sure that we have enough data to differentiate between quality installed batts and the blown-in insulation. I just -- That's a caution.

But in general, I agree. I don't know about the quantification, I'd have to spend some more time to see whether those numbers correspond with what we did, but we did a pretty simple quantification some years ago for CIEE, or it was paid for by CIEE, and our results were very similar to what Oakridge found. And I think that while I didn't see a direct comparison, I think that your results are similar to that. So I think in general, we agree with the whole thing.

I might mention that we're struggling with attic insulation. I mean, heat rises, attic insulation I think is more critical than wall insulation. Wall insulation is a lot easier to address, and I'm not -- this is not a criticism, it's just that's -- I didn't see anything about ceilings in here and maybe you're going there, but --

CONTRACTOR WILCOX: Wall insulation is a lot easier, and that's why we're presenting it first.

SPEAKER HAMMON: Hugely, hugely. And I

understand that. But, at the same time, one thing you didn't show, which I was kind of surprised, Rick, was kneewalls. Because kneewalls are a huge --

CONTRACTOR CHITWOOD: We're dealing with those in the ceiling group.

SPEAKER HAMMON: Okay, all right.

CONTRACTOR WILCOX: Yeah, we're going to follow up with proposed changes for attic insulation, similar kind of approach.

SPEAKER HAMMON: Okay. Not speaking for CBIA, I think that the notion of having a credit for installing things correctly is a good idea. That's basically what we do without any credit within our program. I think it's very important.

CBIA REP RAYMER: CBIA agrees with that. We also like the idea of a more extensive use of protocols into the subcontract, so that in addition of just seeing a reference to the UBC or the UMC or what have you, that there is some quality control citations, specific citations of doing this, this and this, so that the subcontractor is very aware of what's being required at the job.

That, in addition to education, it just helps us over the long term, so that's an area where we're going in all the systems of the house.

CONTRACTOR CHITWOOD: Yes, Bill, question?

CONTRACTOR WILCOX: I have a question.

CEC STAFF PENNINGTON: I'm going to recognize Noah, and then I'm going to stop being the chair.

(Laughter.)

NRDC REP HOROWITZ: Hi, Noah Horowitz with NRDC. At the risk of oversimplifying things, it seems we're coming to the realization that the insulation isn't being put in as well as one would hope, and that the proposed solution is we'll water down or acknowledge that the reference house is using more energy than current. And we're going to give them a credit if better insulation is installed.

And I'm fundamentally okay with that, but with two questions. One, is it realistic that we can actually get the inspectors in there right when it's up, before the drywall goes up, and so we actually need real inspection to occur. And secondly, down the road will this credit go away maybe in the code provision after this so we're no longer giving a credit for good installation practices, but that's the requirement.

WORKSHOP CHAIR ALCORN: Doug?

SPEAKER MAHONE: Is someone going to answer Noah's question, or --

NRDC REP HOROWITZ: So the short-term question is could we talk a little bit more about how the inspection would work, and is that realistic?

CONTRACTOR WILCOX: Well, I think that the model here is the kind of inspections that are in place for duct feeling and so forth in the current standards, and we're attempting to build on those. I think there is -- it's maybe more critical in the insulation cases to work out the timing and so forth.

But even if -- Well, having a good inspection system is a good idea, and so forth, but even if it wasn't a good -- even if you couldn't have a good inspection system, I think it's still the right thing to do to have a realistic characterization of what's really being built.

I mean, reducing the calculated

performance of these walls doesn't depend on having a system to fix them. What we're doing is we're correcting the treatment of those walls in the standards. And even if you didn't do anything else except encourage people to use better foam sheeting systems, as was pointed out earlier, then that's still a step in the right direction.

One of the other things that I should point out here is that there is a plan to do some analysis of cost-effectiveness of insulation that is going to be done as a separate task related to this project that will depend on these new factors. So there's some looking at the optimums under the alternate set of calculation assumptions.

And as far as where the standards will go in five years, who should we ask that question?

(Laughter.)

CEC STAFF PENNINGTON: Well, I don't know if Rick or Marc have a reaction to the question about to what extent is the inspection, you know, going to catch problems and what about the difficulty of timing the inspection. So do you want to respond to that at all?

CONTRACTOR CHITWOOD: Well, I have a

couple of quick responses. I think it's a huge challenge to get inspectors out there with enough -- well, the word is balls -- to tell the builder that the insulation doesn't pass and the insulators have to come back and the project is stopped for a day. That's going to be a huge obstacle. But we're still going in the right direction. So, you know, I think that's good.

The other comment is that even though percentage-wise not a lot of builders take credit for the duct -- the tight-duct credits, you know, that's a fairly small percentage. But just having the tight-duct credits in print and in the code as a credit, I think that spills over into the whole industry. We see better sealing techniques and general tighter ducts, even though they're not taking credit for them, and I think that may also happen with the wall insulation performance.

Once we see a credit for better performance, even the people that aren't taking the credit and aren't getting inspected will know more about the importance of proper installation.

CONTRACTOR WILCOX: One of the issues there is I think we're proposing a sampling approach, so you don't have to inspect every house, for sure. And that's critical to making it work, I think.

WORKSHOP CHAIR ALCORN: Next, and I want to call on Doug, actually --

SPEAKER MAHONE: Actually, I'm going to --

WORKSHOP CHAIR ALCORN: Oh, he's deferring to Nehemiah.

PG&E REP STONE: Nehemiah Stone, Heschong Mahone Group.

I don't see that it does, but I just want to be clear that this change in procedure that we're talking about doesn't in any way affect buildings that do not have cavities in the wall, wall systems that don't have cavities, such as structural insulated panel systems or straw bale walls, for example. Is that -- So --

CONTRACTOR WILCOX: As long as you don't have any voids in those bales.

PG&E REP STONE: Actually, I should have said Nehemiah Stone for California Straw Builders Association, so --

(Laughter.)

PG&E REP STONE: -- so do we have an answer?

CONTRACTOR WILCOX: Well, this change would implicitly affect all of those types of construction by essentially making it easier for them to comply.

PG&E REP STONE: Cool, thanks.

(Laughter.)

CONTRACTOR WILCOX: One of the -- An associated point here. We have some calculations that, the ones that Marc showed the bar chart of, we have Form 3s with the new factors in them, as examples, if you want to see how the calculations actually work. And those are outside on the tables.

WORKSHOP CHAIR ALCORN: I'm sorry, Ken, just before you had, Jeff, you raised up your hand out in the audience. Did you want to make a comment?

SPEAKER CHAPMAN: I wanted to just make a quick comment.

WORKSHOP CHAIR ALCORN: Would you approach --

SPEAKER CHAPMAN: Jeff Chapman with California Living Energy. And consistently the HERS raters that work for me, with me do inspections as Rob's company does. And our goal is quality installation.

And it will take time, much like tight ducts have taken time. You realize, gentlemen and ladies, that every HVAC contractor installed tight ducts before you said that needed to happen, don't you? Just ask them.

But as we work with those contractors, that myth begins to dissipate very quickly. And as our crews, as our raters work with the contractors and say, now, look, the registers are down, look at the sealant between the boots and the cans and the sheetrock. Well, we sealed that -- Well, let's look at the gaps.

By analogy, the same thing is true, I have found, for insulation contractors. Yes, at first, it's a cost issue. That's why most insulation installers are paid by the piece. But as they begin to understand this is the standard, this is what will pass. And it's amazing, the superintendent's ability to help that insulation contractor do it right the first time, once they understand the standard. Thank you.

WORKSHOP CHAIR ALCORN: Thank you, Jeff.

Ken?

SPEAKER NITTLER: Ken Nittler with Enercomp. Along the lines of what Nehemiah was saying, do these same factors apply to two-by-six wood framing, and what about steel framing which occasionally gets used?

CONTRACTOR HOESCHELE: Marc Hoeschele, Davis Energy Group. Yeah, we would apply the same, any cavity insulation would have these factors applied to them, given our proposal here.

SPEAKER NITTLER: Well, what about the framing factor work, then, on steel framing? Is that the 25 percent, I know that wasn't exactly your study, but -- I guess I'm asking these questions wearing a hat that says dealing with implementation a year from now with people --

CEC STAFF PENNINGTON: In terms of the steel studs, that work is not part of ASHRAE's work. ASHRAE was looking at wood framing only.

There is some previous work that Davis Energy Group did in the mid-90s for the Energy Commission where we could actually revisit that question, good question.

SPEAKER NITTLER: Okay, because the way it would work right now, if you had a house with sort of the nominal installation, what our standard says is that you could use steel framing, but it has to have a U factor equivalent to an R-13 wood frame cavity. And obviously, that would make that standard considerably easier to meet.

WORKSHOP CHAIR ALCORN: All right. I'd like to recognize Bill Mattinson and then Rob Hammon and the person at the podium.

SPEAKER MATTINSON: Yeah, my question, first two comments I guess. The first one follows up on Ken and Nehemiah, is that there are a lot of framing systems out there. If we're going to grant a two-by-four on 16 wood, 16 inches on centers, by far the most common but there are others, the steel I just think you're less likely to throw extra framing in, because it's not something that you just tack in as easily as you do with wood blocking and extra studs alongside the primary studs.

But there are some advanced framing systems that people are proposing. There's 24 inches on center, there's a lot of things in addition to just the normal that we probably ought to at least look at and try and improve, along with panelized construction and all those other things.

Then the other comment is, I guess we're just throwing out the IC1 and the traditional building inspector, installation of the insulation. I mean, in my understanding, the inspector is supposed to be there before the wall is closed up and is supposed to be there to inspect the insulation. I recognize that they have a lot of other things to do and thus, we get this poor quality.

But I don't see any building officials here to comment upon their willingness to walk away from that or to -- you know, where that all stands politically with them. I know that CALBO in the past has been reluctant to give up authority over certain components of the building inspection and approval process.

So I'd hope we would solicit some comments from some of our building official friends on that aspect of it.

WORKSHOP CHAIR ALCORN: Thank you, Bill.

Rob?

SPEAKER HAMMON: Thanks for the segue, Bill.

SPEAKER MATTINSON: Okay.

SPEAKER HAMMON: I just wanted to mention, again, back to sampling, I think that's a critical component of this, and that I think if you have sampling and there's a way to make that work, that that's the only way this can work; otherwise, you are going to hold up jobs. You can't be there full time.

That brings us back to the IC1. We're finding with tight ducts right now, we're probably spec-ing about 40 percent of the homes that come through, and that's a rough number, Bill. But probably about 40 percent of the homes that come through are compliance-job spec-type ducts, which is a lot compared to what it used to be.

We're finding in the field the most difficult part of that is the C06R. And that's a critical part of that whole chain, in that the installer is certifying that they're doing it right. And I think that's something, in IC1 I don't think we want to abandon that. I think that we need something similar to that if we're going to go forward with the quality installation of insulation that you have the IC1 element that says, yeah, I'm doing it per R value. And then the next step of that is I'm doing it per quality, and I'm certifying 100 percent of them. And then the rater is coming in and certifying, you know, through the random test process.

So I think, rather than abandoning it, we need to improve it.

SPEAKER STAHL: Hi, I'm Ed Stahl, with Sunworks Construction and the Structural Insulated Panel Association. And I kind of want to reflect a little bit what Nehemiah was talking about. We're talking about giving credits for good installations of fiberglass and batts and voids. And the systems that inherently don't have that, that are solid reduce framing factors up to maybe 25 percent less than what we're talking about now.

Are we going to have a spot in this to automatically credit those systems as well?

CEC STAFF PENNINGTON: There aren't any degradations proposed for those systems.

SPEAKER STAHL: Would there be something written in or could there be something written in that if you use these systems -- because inherently, these systems come ICBO-approved, preinspected, third-party quality control inspected, and it kind of eliminates what he building inspector has to do out there, in terms of qualifying what a good installation for a fiberglass batt would be. It's inherent in the product itself.

If it were recognized, it seems like a lot more systems would be built with these kinds of systems, which is I think the ultimate goal of what we're trying to accomplish now.

CBIA REP RAYMER: Bob Raymer with CBIA. If there's no proposed degradation listing, then you automatically -- I mean, it's obviously apparent that you are getting full credit. So, I mean, it might seem redundant to say that you're definitely getting full credit, but, I mean, it's going to show up very clearly that those types of systems aren't getting the degradations.

CONTRACTOR WILCOX: We talked about actually including some more standard Form 3 calculations for these kinds of constructions in the compliance software and in the manual, so that would be a clear statement of what's going on, and I think an easy way to do it.

CEC STAFF PENNINGTON: Charles?

CONTRACTOR ELEY: I'm Charles Eley. I have three comments or questions. The first one has to do with the analysis that we intend to do to take a new look at insulation levels for both residential and non-residential construction.

My experience in the past is because of the thermal degradation associated with metal, metal studs, the sheathing, insulating sheathing kicks in sooner in the life cycle cost analysis. And if we have the combination of higher framing factors and degradation of bad insulation, which is the most common situation, this is likely to affect the outcome of the life cycle cost analysis.

And it's possible that in colder climates that we could have a requirement for insulating sheathing as part of the prescriptive standards as a result of this. So this is a possible outcome.

The second comment or really question is we need to deal with this comprehensively. I know you've only looked at single-family homes, but we also need to, we need your advice on whether these same kinds of assumptions should be made for wood framing in non-residential buildings as well. Most schools are still built with wood framing systems. There are a lot of other non-residential buildings that are commonly built with wood framing systems. So we're going to need some advice from your team, not just on residential but for non-residential.

And then the third -- Excuse me?

CONTRACTOR WILCOX: That requires a different task work order, Charles, but --

(Laughter.)

CONTRACTOR ELEY: Well, Bill sometimes just increases the scope, you know --

(Laughter.)

CONTRACTOR ELEY: -- and that's why I'm hoping --

WORKSHOP CHAIR ALCORN: It's moving this way, so --

CONTRACTOR WILCOX: Bryan, what do you think?

CONTRACTOR ELEY: Well, you know, we have to make a decision about it, and I'd really make the decision with your advice than without your advice. So if you choose to not comment on this, then we'll make a decision without your advice.

(Laughter.)

CONTRACTOR ELEY: But a decision will be made nevertheless.

CONTRACTOR WILCOX: All right, Charles.

CONTRACTOR ELEY: And then the third thing, you mentioned special inspection for insulation. Are you thinking that you would recognize advanced framing systems like the one Bill mentioned, and would those also qualify for, so you assume 26 percent? I would probably round that off to 25, considering we only looked at ten houses. But anyway --

CONTRACTOR WILCOX: Well, actually, to clarify, the framing factor stuff is based on a much larger study. That's not connected to the ten houses.

CONTRACTOR ELEY: All right, but would you recognize some type of advance framing system that could also be verified through special inspections and where you could go back down to 18 percent or 15 percent or something for a particular construction system?

CONTRACTOR WILCOX: I think the only issue there is whether or not there's a procedure defined to do it, and I don't know if that's -- is that included in the current guidelines for that?

CONTRACTOR ELEY: Well, there are several specifications around for advanced framing systems. None are referenced in California, but I know in Canada and Washington and lots of other places.

CEC STAFF PENNINGTON: One reaction to that is that it's quite labor-intensive to be determining the amount of framing building. You know, it might take two hours to get a good feel for it, a good accurate feel for it. And I don't know if that's cost-prohibitive for -- I mean, if there's some very observable different framing system, then maybe --

CONTRACTOR WILCOX: Clearly, the situation is open to that. But I just don't know of a solid sort of compliance level proposal we can put out there.

CONTRACTOR ELEY: Well, it seems like, I mean, some of the slides we saw showed systems that looked okay, but you have to kind of pull away some of the insulation and make sure it's not spanning electric wires and so forth. So even the insulation inspection, it looks like to me, is going to take at least a couple of hours.

CONTRACTOR CHITWOOD: It takes an experienced inspector, but once you're experienced you spot those things; you know that there's a wire back there because of the electrical boxes, so you look for it quickly. So I don't think the inspection would be very time-consuming for an experienced inspector, somewhat of a learning curve.

CONTRACTOR ELEY: Have you estimated how long it might be?

CONTRACTOR CHITWOOD: Probably three to ten minutes.

CONTRACTOR ELEY: Per house?

CEC STAFF PENNINGTON: Per house.

CONTRACTOR CHITWOOD: That's what I would think.

CONTRACTOR ELEY: Ten minutes per house?

CONTRACTOR CHITWOOD: Well, let's ask Rob, he's doing those.

SPEAKER HAMMON: My experience is it's going to take between a half-hour and an hour to do a good job.

CONTRACTOR ELEY: That's what I would think, yeah.

SPEAKER HAMMON: I mean, I'd love to learn how to do it in three to two hours, but about a half-hour to an hour, depending on the size of the house.

SPEAKER MATTINSON: I think that would be especially true if that inspector was trying to quantify. I mean, as it is now, you're doing a visual inspection; you're sort of giving it a thumbs-up, thumbs-down. But if you're going through to see if you've got, you know, 69 percent effective or a 79 or an 89, you're going to have to take more time.

CONTRACTOR CHITWOOD: Right, and that's a hard line to draw.

SPEAKER MATTINSON: Yeah, really, incredibly hard.

CONTRACTOR CHITWOOD: And for me the inspection is pass/fail, so as soon as I see a spot that fails, it's time to leave and the insulation installers are back there.

SPEAKER MATTINSON: But if it's just a pass/fail situation, nobody is going to try to take advantage of it. I mean, it's going to be very difficult to get people to seek it out.

SPEAKER HAMMON: I agree with Bill. I think from our perspective, you referenced engineered for living or environment for living program, which claims a zero tolerance program, and I haven't gone into any of their homes, and I'm sure they're doing a great job.

We don't go for that. We're going for about 90 percent, and that's achievable. And so that means you do have to spend some time in the house and make sure that you're getting that 90 percent and it's a fuzzy number and, you know, there are difficulties with doing it that way.

CONTRACTOR CHITWOOD: That's a much harder inspection.

SPEAKER HAMMON: Yeah, but I think it's more achievable.

WORKSHOP CHAIR ALCORN: We need to just make an announcement that there's going to be a little bit of an interruption where we need to dial in to a line where there are a couple of outside callers that are trying to call in, and we need to make the connection.

So I'd like to continue the conversation, but there will be a little bit of noise from dial tone and speaking in the back.

The next speaker, if we could just let Nehemiah make one comment in response to a question, and then the person in the back.

PG&E REP STONE: Very quickly, there is

a standard in California on framing that goes beyond the standards that was done by NRDC, and it -- the inspection on at least that portion, whether it's above standard framing or not is actually pretty -- can be simplified, you can't catch -- you won't catch everything, but essentially, you inspect to make sure the studs and the ceiling joists, rafters are lined up.

And if you've got that, then you have a tremendous reduction in the amount of wood that's being used. And that's a real simple pass/fail, at least on the framing portion.

WORKSHOP CHAIR ALCORN: Thank you.

SPEAKER VEZINA: Hi, Doug Vezina with Owens Corning, standing in for Dave Ware, who may be trying to dial in right now.

WORKSHOP CHAIR ALCORN: Yes, he is.

SPEAKER VEZINA: Just a couple of comments. On the expectations of what the insulation contractor is supposed to do as far as installing insulation right, I know that in the city of Brentwood, I know that they require that all insulation contractors view a videotape that I think is produced by NAIMA on proper insulation, and they expect the insulation contractors to install insulation to that level, which is the best way.

As it relates to the discreditation of the thermal performance for fiberglass batts at about 31 percent degradation I believe was the recommendation, it seems rather subjective and high. It's almost like saying one out of every three or four cavities is not insulated. And I think overall we can agree that most cavities are insulated. And so that 31 percent, I'm not quite sure how that number was derived. It just seems a little subjective, seems a little high.

And then finally, on the blown-in blanket systems or blown-in batts which are used with various products, cellulose or fiberglass, that's basically a remanufactured product on the job site, subject to the expertise of the installer. Fiberglass batts have an assured R value, as certified by NAHP protocol, so we know what the R value of the batt is that's installed.

Blown-in batts or blankets in cavities can vary dramatically, depending upon the density that's in that cavity, the number of bags, etc. It's very hard to tell from an appearance or a visual standpoint. So those are just some comments I wanted to make. Thank you.

WORKSHOP CHAIR ALCORN: Thank you.

Are there any more comments out in the audience? Oh, Noah, sorry.

NRDC REP HOROWITZ: As with always -- Noah Horowitz, NRDC -- I think the devil is in the details. It's worth pursuing this further, but just listening to some of the dialogue, is the inspection simply a pass/fail, or is there some sort of algorithm and you need to hit a score? That will I think drive how long it takes and what the cost and likelihood.

And then we need to come up with some sort of sampling protocol, you know, what percent of homes would actually be sampled. And then once people take a look at that, I think they can tell whether this is the starter or not.

WORKSHOP CHAIR ALCORN: Okay. I'm going to ask if -- Noah, I'm sorry -- if Dave Ware or Charles Cotrell are on the line? Hello?

I suppose what we're going to have to do is move on. We may -- I'm not sure if we're going to want to come back to this subject for their comments once we can make a connection with them.

For now I think we're --

UNIDENTIFIED SPEAKER: One more try we're going to make.

WORKSHOP CHAIR ALCORN: Okay.

I think we're going to have to go ahead and move on. The next topic is Improvements for Existing Homes, Windows, and I'd like to recognize Misti Bruceri to start this topic.

PG&E REP BRUCERI: Good morning. My name is Misti Bruceri with Pacific Gas and Electric Company, and I'll be filling in for Marshall Hunt today.

PG&E is attending today to present the first of eight residential standards proposals that we are preparing, and this one is entitled Improvements for Existing Homes, Windows.

UNIDENTIFIED TELEPHONIC SPEAKER: Hello? Is there someone on the line?

CEC STAFF PENNINGTON: Are you on the line, Dave?

WORKSHOP CHAIR ALCORN: Charles?

UNIDENTIFIED TELEPHONIC SPEAKER: Misti, are you on the line?

(Laughter.)

PG&E REP BRUCERI: I'm Misti.

WORKSHOP CHAIR ALCORN: I'm sorry, Misti.

PG&E REP BRUCERI: That's all right.

Should I continue, or --

WORKSHOP CHAIR ALCORN: Let's go on ahead and continue.

PG&E REP BRUCERI: Okay.

WORKSHOP CHAIR ALCORN: Sorry.

PG&E REP BRUCERI: The proposal is called Improvements for Existing Homes, Windows, and it details some recommendations for window requirements for replacements of windows in existing homes. We brought a full report that details all the analysis assumptions, research and cost and savings estimates that is on the table outside.

And the report was prepared by Ken Nittler of Enercomp, and he's here to present the details of that study, so I'd like to turn it over to him at this time. Ken?

ENERCOMP REP NITTLER: Thank you, Misti.

Good morning. I'm Ken Nittler with Enercomp, as Misti just said, speaking on behalf of PG&E and their codes and standard effort.

What we're going to talk about today is replacement windows, but it also goes a little bit beyond that. Out on the front desk there is a separate little handout, six or seven pages, that has the details backing up my presentation today. And there are also copies of the overheads available.

Historically, replacement windows are providing an exemption in the current standard. This dates to the early '90s when really window products and NFRC ratings were introduced to the standards. They represent a large opportunity in terms of energy savings, and as I'll present today, I think we'll find that they're life cycle cost effective when we look at them on their own.

The window market in California has something on the order of 5.5 million windows installed every year. Maybe 27 percent of those, about 1.5 million, are replacement windows. The balance go into both new and remodels. Roughly, about half of the windows installed are in new construction, so another 23 percent of the windows would be installed in remodels.

The replacement market in the window industry is affected by many factors, and there are many different ways that homeowners get replacement windows. But one of the most popular ones, one that's really emerged in the last ten years or so, is that you buy your windows through a replacement contractor. They come in, they measure your windows, they give you a bid, they do all the knockdown work on the existing product and install the new window product in the opening.

If you open your daily paper, like the Sacramento Bee here in Sacramento, in the first section, in Section A, on any given day you will find ten ads to do replacement windows. And I don't have an exact figure, but it's a very large portion of the replacement marketplace is done by replacement contractors that specialize in windows or maybe also HVAC.

One of the unique things about this proposal and replacement windows is that I guess what we're arguing for here is that when the consumer has made the decision, when the homeowner has made the decision to buy a better, to install a new window. What we're after is getting them to install the energy-efficient product. So we're not, as part of our life cycle cost analysis, including in our cost basis how much the total cost of replacement; what we're talking about is the added cost to go from the window that's already being installed to making sure that it's an energy-efficient window.

And those of you who are familiar with this market, and in the paper I detailed just sort of a loose example, it's not atypical to find that a replacement contractor might charge 500 bucks to replace a window. Now, the actual cost of the window might only be a hundred dollars. The added cost of going to an energy-efficient window, one with a low U factor and a low solar heat gain, might be on the order of $30. So we might be talking five or ten or fifteen percent of the total cost is involved with upgrading and making sure that these window products are the efficient ones.

So it's not quite the same as some of the other products, where you're bearing the full cost when you look at the life cycle cost. We're only going to bear a portion of it. And there's nothing in this regulation that tells homeowners they have to go out and buy new windows. It's only after they've made the decision that these proposed amendments would apply.

One other factor in the replacement industry is that a large portion of that industry is already selling and installing highly efficient windows; in fact, probably of all the marketplaces that have already transformed into a low conductance frame, like a vinyl frame, and a low solar gain glass or a low E glass, I think market is probably two or three times as high penetration as it is in new construction right now.

In the paper there are details of a somewhat simple analysis of energy and cost savings. One of the challenges when you're looking at replacement windows is think of all the different types of houses you have out there -- different sizes, different climate zones. It's pretty intimidating to sit down and think how you would go through and analyze each of those various categories and end up with an estimate of what the life cycle cost might be.

We did an analysis where we looked at the database, the DEER database to establish average energy use for existing construction. It turned out that when you apply reasonable savings estimates that we end up with maybe 16 therms and 324 kilowatt hours as the potential savings, and that's average across the state. That's average, including valley climates where there's higher cooling, and coastal climates where there's no cooling; large houses, small houses. It's really an economic analysis of what the average savings might be.

On the cost side, we looked at cost -- You could argue in many cases that the cost of this requirement is zero dollars, because the homeowner is probably already in many cases installing a product that meets this criteria. At the other extreme would be people that do need to upgrade their products, and the sort of par value that we ended up looking at is $1.50 a square foot. And that's $1.50 for going from a metal frame to a vinyl frame, and a second $1.50, if you will, to go from clear glass to a low E glass. So potentially you're talking as much as $3 a square foot.

When you look at it on a house basis, the added cost is somewhere between, say, $335 and $670. The analysis presented in the paper estimates the net present value of the energy savings at about $895. So basically, since the added cost is lower than the net present value of the savings, we have a product that meets our life cycle cost effectiveness that we're applying elsewhere in the standards.

So what are other proposed changes? It's a series of changes to Section 152, and also a little bit to the definitions. 152 is the portion of our standard that applies to additions and alterations.

I put this little key thing, it's supposed to flash, I'm not sure what's happening here, but this is one of the most important slides. Because I think it illustrates what the principal was behind these proposed changes.

Generally, the goal of these proposed changes is to make all fenestration products have to meet the package criteria for U factor and solar heat gain, and, in most circumstances, the area requirements that we find in our prescriptive standard. That's the objective.

There's a standard sort of safety valve here, in cases where the builder or the homeowner would like to void this criteria, for whatever reason, and it's called the existing plus alteration approach that's already recognized in our current standard. So if somebody wanted to come in and match a few existing windows, some calculations could be done. And if they made improvements to other portions of the structure, then presumably they could install the windows of their choice. So there is sort of this built-in safety valve.

As Noah was noting, the devil is in the details. And trying to craft language that captured replacement windows but doesn't also snare repair turned out to be a challenge. And I'm not going to go into each of these definitions, but the next couple of slides highlight a few of the key things that are already in the standards, and they form the basis of the definition of replacement fenestration.

So, in addition, it is any change to the building that increases floor area or conditioned volume. And generally speaking, the changes we're proposing here aren't for additions. We're not talking about cases where people are adding floor area or the remodel case.

Alterations is any change to a building's system, blah, blah, blah, or envelope that is not an addition. So that's really -- the word "envelope" is underlined, that's the case we're trying to get here.

Now, there is also a definition in the standard of repair, and it has additional wording in there as well, but basically it's the reconstruction or renewal of any part of an existing building for the purpose of its maintenance. And we've provided a note to our definition that hopefully captures that case in a reasonable fashion.

Another definition that affects how you write this sort of code language is we wanted to rely on the definition of the manufactured fenestration product that's already in our standard. The reason for that is if you have a manufactured fenestration product, you're subject to Section 116 and Section 10-111 of the standard. That's the criteria that says you have to have NFRC ratings and labeling and be part of the certification program, and it's something that's required of all the other windows that go into new construction.

So here is the definition, and I've underlined -- another one of my key slides -- I've underlined a couple of key operative words. Replacement fenestration is an alteration -- so that's establishing, hey, it's an alteration, make it real blunt -- to the building envelope where all of the glazing in an existing fenestration opening is replaced with a new manufactured fenestration product.

Now, you might ask, boy, that sounds like a lot of words for something that sounds pretty simple. The awkwardness that we encountered is that one of the most popular types of replacement right now is you don't actually remove the existing window. They come in, you cut out -- you knock out the glass, you cut out the existing sash or interlock, the vertical piece you'd see on, say, a sliding window. And then you fit a custom-manufactured window into the existing opening, but the existing frame is still there, the weather barrier hasn't been removed or adjusted.

So we were trying to find language that would capture that case, as well as the case when somebody is removing the entire product and framing it in as you would a new construction window. So that's our attempt at that.

There is a note added to this, this really would have belonged on the previous slide but it got too small to read, so I put it here. "Note: Glass replaced in an existing sash and frame, or replacement of a single sash in a multi-sash fenestration product are considered repairs."

So I'll let that sink in for a minute. I have another slide here in a minute that goes into more detail on it. Okay, so here are some examples of cases where I believe that they are covered with our definition. The frame, sash and glass is removed and replaced with a new window. So that's a straight replacement, they're knocking out the old window entirely and putting in a new window.

The second case is the sash and glass is removed, and replaced with a new what the industry often calls a retrofit window. And that's the case that most of our replacement contractors are using today.

The third case can happen, especially in neighborhoods where there are older windows, maybe older double-hung windows, wood frame double-hungs built into anywhere from when California got rolling into the 1940s or '50s, where people need to replace sashes. And what we're saying here is the test is that if you replace both sashes, then you come under this criteria.

So here are some cases that are not covered. And the first one is the baseball going through the window. If you're just fixing broken glass, we're specifically saying that is not covered. The second item here points out that if the sash and glass on the bottom half of a window is replaced, then that doesn't trigger this criteria.

And the final one, an existing window is removed and the opening is enlarged to install a sliding glass door. Well, that's actually an alteration. That's not a replacement. And alterations already do fall under the standards, and I'll explain some other differences here in just a moment.

So let's go on and look in just a little more detail about what these proposed changes are. So for replacement windows, we remove the exemption that provided an exemption for replacement windows, and this clarifies that the replacement fenestration is to be considered as an alteration.

We maintained language, although we

revised it slightly to establish that repairs are still exempt. When you look at the details of how the language is crafted, the third bullet there really is the whole point, is that we're making the replacement windows subject to package criteria for U factor and solar heat gain coefficient, like all the windows used in new construction and remodeling already.

This is the exemption that's already in Section 152 that we're deleting in its entirety, so that would be replaced by the text we're proposing.

Now, in studying Section 152 in great detail, those of us working on this sort of concluded that there were some improvements or modifications that probably should be made to additions and alterations, so I have a couple of slides that talk about that.

The first one is that we're now required or the proposed language requires that additions of any size meet the package U factors. If you read the standard right now, you'll find that there are exemptions on buildings less than 100 square -- or additions, excuse me, less than 100 square feet and less than 500 square feet, that says all you have to do is meet the .75 U factor, instead of the package value that you find in tables for the prescriptive packages. So we're proposing removing that so that alterations and additions also have to meet the package criteria.

It's interesting to note that the current language already requires the solar heat gain coefficient to be met, just not the U factor. And if you know very much about how these products go together, it's pretty hard to get a product that beats the solar heat gain requirement of, say, .4 in a valley climate or a desert climate that doesn't also meet the U factor requirement already.

On alterations, some similar sorts of changes. One thing we also attempted here is to close a loophole, a longstanding loophole that says that if you're doing an alteration, there was no area restriction. You can come in under an alteration, conceivably replace an entire wall with windows, and because it was treated as an alteration and there wasn't new square footage associated with it, you could do whatever you want.

So we've attempted to -- we're

proposing to reduce the chance that that's a loophole and make alterations subject to the total glazing percentage that you find in the packages.

Additionally, we're also saying that alterations have to meet the U factor, just as we talked about on additions. And again, interestingly enough, prescriptively, you already have to meet the solar heat gain criteria, which is more than half the battle anyway.

Now, just a couple sort of final comments here. Interaction with other changes, and currently our standards reference a metal-framed product, generally in the standards. In the valley climates it's got a U factor of .65 and a solar heat gain coefficient of .4, as an example. In the milder coastal climates, the U factor goes up to .75 with any solar heat gain that you'd like. Typically, these are aluminum dual-glazed products is what they amount to.

There is also I think forthcoming from the Commission a proposal that will quite likely be recommending reduced U factors as part of this standards revision. So the way the language is written here, we're pegging replacement standards and the changes I mentioned for additions and alterations to the package values. So if the package has changed, these proposed changes go right with it.

Now, this is the obligatory picture of the California climate zones, so nobody else has to present this today.

(Laughter.)

ENERCOMP REP NITTLER: But basically, it amplifies the point I just made, that the current standards are generally aluminum products. 2005, with heavy question marks there, I don't think this work is complete yet, but it's possible that the standards are going to be moving towards a non-metallic or a vinyl/wood-type frame product that typically have U factors down in the .4 range, and solar heat gain coefficients in the .35 range.

One other interesting note, and then I'll stop and take comments, is the way the standard is written, when you say that there's a solar heat gain coefficient requirement, within the standard there are actually four alternatives to meeting that. And it seems like, especially in the replacement case, where maybe there are existing overhangs, there's a possibility of things like exterior shading products, shade screen, things like that.

So I just wanted to point out that this maintains those four possibilities. I think overwhelmingly what will be installed is the first one, that the fenestration product meets the package requirements, but there is a little bit of flexibility built into the way that the standard is designed already.

WORKSHOP CHAIR ALCORN: Questions? Bob?

CBIA REP RAYMER: Yeah. The first one, I guess a question for Bill and anyone else familiar with the work that's currently being done. How would you propose this to be enforced? How would you envision, given previous proceedings, how would you take a crack at that?

ENERCOMP REP NITTLER: Well, I think that the enforcement issue comes down to whether there's a building permit involved or not. My personal belief, along the lines of what Rick and Bruce were saying a few minutes ago, you know, even if there isn't building permit pulled, it doesn't mean people aren't supposed to follow the Building Code.

So there will be cases where, even in the absence of building permit, that this will have sort of a spillover effect and encourage and foster a market that rewards the higher performance product.

I don't have good estimates of what percentage of the time building permits are pulled on these. From talking to the replacement contractor types in the street, I can tell you it's low. I don't think it's zero, I don't think it's 25 percent of the time, I don't know what the number is.

CBIA REP RAYMER: Food for thought for the Energy Commission staff. Given that you are talking about a sizeable amount of money here, it would involve licensed contractors from the Contractors License Board. And so they are, as part of maintaining their license, they're to be following the rules and regulations of the state of California.

And so that's another avenue, other than building officials, that you might want to look at. I mean, CBIA is very interested in pursuing energy efficiency in the existing housing stock, so if there's more than one way to skin a cat here that might be the way to go.

CEC STAFF PENNINGTON: And I suppose what you're talking about there is working with the Contractors State Licensing Board to let contractors know of their obligation, and primarily you're thinking about an information vehicle to communicate that. And I guess there's always a complaint process and a licensure issue that you could pursue.

My distant experience with that is that that is a -- I don't know how to characterize it, it's an arduous process to go through some sort of a license challenge, and it doesn't happen very often. And it's -- I'm not sure, that's -- You might have some example cases where, you know, someone's licensure is brought into question as a result of a failure to comply. That might be information to the industry that they should pay attention to the requirement.

But it's sort of not a good sort of day-to-day way to get the standards enforced. It's maybe a support approach.

CBIA REP RAYMER: Yeah, it certainly would be ancillary to a building official and a permit.

CEC STAFF PENNINGTON: Right.

CBIA REP RAYMER: But at the same time, the legislature is taking a very -- over the last, say, five to six years they're really taking an increased view of the unlicensed contractor involved in home repair. And this could be another area that you can use it as an educational vehicle, and, I mean, it's one more regulation that they need to be aware of if they're going to do the proper job under the rules of California.

So it's just one other opportunity.

CEC STAFF PENNINGTON: So I'm taking it that CBIA would be interested in working with the Energy Commission on that kind of communication with the Contractors State Licensing Board?

CBIA REP RAYMER: Yes.

WORKSHOP CHAIR ALCORN: Okay. I'll recognize Noah.

NRDC REP HOROWITZ: Noah Horowitz, NRDC. We think this is a potential great addition to the standards and encourage continued pursuit of it.

Ken, I didn't read the analysis that came with this, but did you crank out any numbers in terms of, on an annual basis, what the savings would be? That would be a good number to know.

ENERCOMP REP NITTLER: Yeah, on the paper it was from two different angles. One is a per-home savings, which was on one of those slides; and then two, trying to get a beginning estimate of what the statewide impact would be.

I believe the factor I used is I made the assumption that this would only impact about 25 percent of the replacement windows. Because my experience, from talking with people in the field, is a huge percentage of the windows that are replacement windows already meet this criteria.

It's like I went through the mathematics with -- it turns out that maybe 100,000 homes a year have replacement windows installed in California, so it does go through the math and estimate some statewide impacts.

NRDC REP HOROWITZ: Okay, great. The second part, if I may, is I agree with CBIA's point that any work we can do to increase the percentage of homes that actually pull a permit through education and enforcement, that will more likely result in a better window being put in.

Thanks.

WORKSHOP CHAIR ALCORN: Bill?

SPEAKER MATTINSON: As someone who has spent a huge amount of his time for the last five years advocating better windows and training industry on it, I'm really strongly in support of this. But the other part of my time has been as a practicing energy consultant, much of it involved with houses, in particular along the north coast -- Sea Ranch, Bodega Harbor, and all those sorts of things.

And this is a question that I'm going to get asked that I'd like to be able to answer in a reasonable fashion after these rules come in, and that is that many coastal communities and perhaps others throughout the state have had a mandate under local CC&R requirements for certain looks, certain kinds of window products.

For example, those two that I mentioned have required a bronze anodized finish, they don't like white windows. You know, I don't -- it's not my thing, but there are several thousand homes out there that have that, and there are -- other than some wood windows that are clad with a bronze aluminum finish, there is very little product out there as a replacement available to them that would meet those CC&Rs. So there are going to be objections, where even if the homeowner wanted to put in a white vinyl window to meet the U value requirements, they would be challenged on a local basis.

So I'm not saying the local requirements are correct or should be continued, but we'll be up against that. And then the other aspect of it is that in those same climate zones and quite a few others, to get to the U factor that may come in under -- you know, that Ken said was under discussion for these standards for all homes, with prescriptive U factors which will be significantly lower than they are now, that will require the use of low E glass to bring the U factor down, all of which is good.

The problem in coastal zones is in many -- and Nehemiah was probably about to comment on this too. In many cases, you want high solar heat gain, low E, because you want to let in as much solar heat as you can in a heating climate, in a non-cooling climate. And, unfortunately, to my knowledge, that is not available, that product is not available in California, by California manufacturers, anyway, or by the major distributors who sell windows into California. If you want low E, you get low solar heat gain low E.

So I'm not trying to move the rule to accommodate these exceptions, but I'm just pointing out that there are some cases where there will be some strong local vocal exceptions that as an energy consultant, we need to be able to explain why, and what the benefits are. And if the benefits don't land on them and their house, there is going to be confusion.

ENERCOMP REP NITTLER: On the second issue, Bill, at least as I'm familiar with it, the proposals that are forthcoming on lowering U factors for those climate zones in the coastal regions, goes to a vinyl with clear glass. It doesn't go to a vinyl with low E glass.

SPEAKER MATTINSON: So it would be more like a .55 instead of a .4 something?

ENERCOMP REP NITTLER: So something like that, if you looked at the default tables. That may not be an issue or maybe it is, but I don't know.

On the bronze anodized example that you gave there, I guess my answer would be that that's why there's the exemption on the existing plus alteration. And if, in a particular case, people would like, for whatever reason ones like you're describing are possible, they could use that approach, to trade off the better window, install the window that meets the CC&Rs, and upgrade some other component, say insulation in an attic or a water heater, some other building component.

SPEAKER MATTINSON: That's certainly doable for older homes. For relatively recent homes, it's tough, but I don't want to argue this point or advocate it, really, just wanted to point it out.

WORKSHOP CHAIR ALCORN: Okay. Bob Raymer, did you have a comment?

CBIA REP RAYMER: If we're trying to foresee potential pitfalls coming up, the last time this really got great debate in '95, there was a rather large and very vocal group of replacement manufacturers, replacement window manufacturers out of the Bay Area that were very vocal, and actually, if I remember correctly, they even went to the legislature.

And so I would anticipate that that would in some way have to be dealt with.

WORKSHOP CHAIR ALCORN: Thank you, Bob.

Nehemiah?

PG&E REP STONE: Yeah, actually that was one of the points I wanted to speak to. It was '92, Bob, not '95. And Chairman Imbrecht and Senator Kopp and I met with those replacement window folks, and they agreed that they could be ready to meet the standard by '95.

So if they're not ready to meet it by 2005, something went way wrong. They were originally supposed to be covered in '92, and the Commission agreed to back off until the next round. So it's high time.

Since I'm up here, let me make a couple of other comments I wanted to make. It seems to me that it might be appropriate to take a look at the same sort of change for high-rise residential. It's not uncommon for high-rise residential to go through and just change out all the windows. Why shouldn't they have to meet the prescriptive requirements at that time?

Also, in looking at how the Commission can get the information out and, therefore, get better compliance without having to push into the time of building inspectors as much, there are a number of glass associations; in particular, California Glass Association, which deals very much with those replacement folks. They have a couple of opportunities a year for the Commission, CBIA, anybody to go and make presentations to them about these changes.

And the last point I wanted to make is that having been a licensed contractor, I know that you get a report a couple times a year from the Contractors State License Board that tells you how many people have had their license suspended and for what. And for me, as a licensed contractor, that report made an impression on me. So, Bill, you may be right that, you know, it only follows through to the end of actually taking somebody's license away in a very few cases, but everybody that reads that notes those cases and it makes a difference.

WORKSHOP CHAIR ALCORN: Thank you, Nehemiah.

Tom Trimberger?

CALBO REP TRIMBERGER: Tom Trimberger representing CALBO. One of the issues that's come upon, that we've stumbled on with this a couple times is state housing law, which basically says that you're not mandated to bring things up to new safety codes and such, that you can always put it back the way it was, it was put it in legally the first time. They're specifically mandated from making you upgrade that component.

Has there been progress on that, or we just haven't figured that out yet?

CEC STAFF PENNINGTON: Well, there's been -- we've had attorney-to-attorney discussions with HCD about that topic. And our attorneys say that that's a statute that applies to HCD, and that the Energy Commission doesn't have that same limitation on it.

CALBO REP TRIMBERGER: Okay, well, that's something that's enforced by the building official too. It's right there in the state Housing Code, applicable to every residential building in the state. So how can it apply to them but not to you, and where do I as a building official figure that out? Did HCD agree that you could play with the rules now?

CEC STAFF PENNINGTON: Agreed to stop arguing with us, I think.

(Laughter.)

CALBO REP TRIMBERGER: Until later, or --

CEC STAFF PENNINGTON: You know, the

requirement is in their statute, it's not in our statute. And so it applies to regulations that they adopt.

CALBO REP TRIMBERGER: So have they -- are they going to look at revising that statute by 2005, then? I'm really not being facetious. This is real life.

CEC STAFF PENNINGTON: I mean, I suppose the Energy Commission can provide, you know, legal guidance to the building officials about this question related to compliance with the Commission standards.

CBIA REP RAYMER: Tom, if I could, through you to Tom, the Health and Safety Code 17922 and subsequent sections certainly does speak to the Department of Housing and, to a lesser degree, the state fire marshal in their adoption of the regs and how those regs could impact existing housing. And, I mean, it dates back 25, 30 years, some of these provisions that were changed.

The legal counsel for the CEC brings up a very curious point in that 25402 of the Public Resources Code and subsequent sections doesn't have that type of joining language, and so why --

one could argue that HCD clearly does not have the authority to regulate existing windows to the point of requiring a change. It's unclear as to how that would prevent the CEC from pursuing this type of endeavor.

Certainly, when we did AB549 last year, this is going to be one of the issues we wanted to thoroughly investigate and find out if the legislature needed further suggested direction or what have you. But I think there is some confusion in the statute here. And obviously, the Energy Commission's regulations under the Warren-Alquist Act have come on board after all of this got done with the state housing law.

But at that time HCD was the only game in town when it came to housing regs. So it is, it's a confusing point.

CALBO REP TRIMBERGER: It's only confusing in those cases where a permit is required.

CEC STAFF PENNINGTON: One suggestion that was made earlier, maybe an indirect suggestion was that perhaps the communication with the Contractors State Licensing Board is to communicate to contractors an obligation to get building permits.

Is that something that CALBO would be interested in pursuing?

CALBO REP TRIMBERGER: Getting building permits where required, yeah, but I think there are a lot of cases where the building official says no, I don't need to look at that. There are things that yes, they need to be done by code, but you don't need a permit for it.

CBIA REP RAYMER: Right. You've got 500-plus jurisdictions and what triggers a building code in one may not be what triggers it in another.

CALBO REP TRIMBERGER: Yeah, most -- I did an informal survey of my chapter and there were maybe 30 jurisdictions present, and I asked them which -- if you're not changing the framing, do you require a permit? And one of the 30 did; 29 did not.

WORKSHOP CHAIR ALCORN: All right. Are there any more comments on this topic?

Okay. Hearing none, I think we can move on to the next report. This is Water Heating Distribution Loss Performance Improvement Options, and Marc Hoeschele from Davis Energy Group will be presenting.

CONTRACTOR HOESCHELE: Our basic charter on revisiting single-family distribution loss was to evaluate whether we can define with more precision how distribution losses vary with building floor area and number of stories in single-family. There is also work ongoing in multi-family water heating, which Nehemiah and HMG are leading the effort on. We're working with them and that will be presented at the May workshop.

Currently, water heating -- the current water heating model, as you look at the first slide here, shows four components to total water heating end use for your typical natural gas water heater. Starting at the right, you have end use, which is the water used at the fixture of the appliance -- the bathtub, the shower, sinks and so forth.

From there you have distribution loss, which is how much energy is wasted getting that water to the fixture, and that's primarily a function of between draws. As the water sits in the pipe it cools off, and when the user desires hot water, it's not hot, and the energy in there is typically thrown away or it has already been lost to the environment.

And the combination of end use and distribution loss is what's commonly referred to as recovery load, which is what the water heater sees. The combustion loss reflects what the efficiency, how efficiently the water heater converts the fuel input to useful energy, and then finally standby loss of the tank itself due to tank losses and the pilot light.

In developing this new work, we relied on HW Sim, which is a program that Davis Energy Group developed for the 1992 standards when water heating last underwent significant updating. And that model is an event-based model which takes a layout for a distribution system for a particular house, and you lay out the piping, the mains and branches from the water heater to each fixture. And then you impose a system of loads, a system of draws at the fixtures with a schedule. And the program updates temperatures in the lines using decay constants that are based on the size of the pipe and the materials of the pipe and the environment surrounding it.

So the work that we did for this

current 2005 study, the assumptions are consistent with what was originally done, and we were just updating to try and get a better handle on some of these issues. The process in evaluating this study was to select a range of typical, actually actual houses, and we looked at from 960 square feet to over 3,080 square feet, both one- and two-story.

For each of those houses we laid out the piping system, we sized the piping system from the water heater to each of the fixtures, and those inputs were input to the program. And then fixture loads were built up based on the current usage quantities that are in the water heating methodology, which currently bases recovery load dependent on floor area up to 2500 square feet.

So there is a relationship, as the floor area increases, the recovery load increases until it's capped at 2500 square feet. So once we selected a house size, that defined the recovery load for that building. So the loads were built up from that.

This is just one sample of a house that we evaluated for the water heating analysis, and it's a little bit hard to -- this is about a

2,000-square-foot single-story, water heater in the garage in the right corner, and then the fixture locations, the bathrooms, laundry, kitchen, and the master bathroom.

This is the use quantities, and this data derives from the 1991 study, where we extensively looked at prior research on water heating consumption, where water is used and what typical draw quantities are. So this table summarizes what the usage is at each fixture, what's assumed in the HW Sim program. We have two types of kitchen draws, either one-gallon or three-gallon, lavatory draws, shower draws of either ten or twenty gallons, dishwasher, clothes washer, regular bath draw, and in some of the larger houses you'll start to see the whirlpool tub, so that has the larger volume.

Associated with that the second or the third column is assumed use temperature, and that's what temperature the person drawing the water is looking for. For shower and handwashing sink draws, we are assuming 105 degrees is the mixed water temperature they're looking for. For machine draws -- dishwasher, clothes washer -- and clothes washer usage has been adjusted, the volume usage has been adjusted to reflect the mix of hot water or cold water or warm water usage by clothes washer, but there the water being drawn is exclusively hot water.

So from these usage quantities and our recovery load target, we build up a pattern of usage that matches the target recovery load. HW Sim then goes through, has the ability to simulate a seven-day period. So we could change the loads, each day could be different. Typically the variations were small between days, but there were weekend/weekday variations, which reflect higher usage on the weekends, and more clothes washing and so forth.

So with these inputs, then, and the time intervals between draws, the program calculates how much energy is used, end use distribution loss, recovery loss, and standby loss.

SPEAKER HAMMON: Excuse me, Marc?

CONTRACTOR HOESCHELE: Yes?

SPEAKER HAMMON: Rob Hammon, ConSol. I'm confused by one line here. The clothes washer?

CONTRACTOR HOESCHELE: Yes.

SPEAKER HAMMON: It says you assume a mix of hot, warm, and cold cycles, yet you've got the same gallon on the volume of the draw and the volume of hot. I didn't understand that.

CONTRACTOR HOESCHELE: Well, basically in getting to that 9.1 gallons, that was based on 80 percent standard washers, 20 percent horizontal axis, and the typical -- I think it goes back to the DOE assumptions for volumes and what the percentage of each load is. And in the simulation, we didn't say that one draw was a hot water load and one was a cold, we just applied the average 9.1 gallon usage to each clothes washer draw.

And so that's how much hot water is consumed, taking into account the mix of different loads you have. So the total volume of water consumed is greater than that, but it's 9.1 gallons of hot water.

SPEAKER HAMMON: Okay.

COMMISSIONER ROSENFELD: I think you should have just put the asterisk on the 9.1 --

CONTRACTOR HOESCHELE: Yeah.

COMMISSIONER ROSENFELD: -- and then said of equivalent hot water.

CONTRACTOR HOESCHELE: Yeah, okay.

SPEAKER HAMMON: Yeah.

CONTRACTOR HOESCHELE: So this graph then summarizes for the house types the eight different plans we looked at, the open squares being two story and the solid triangles being one story. It shows the variation in distribution loss as a percent of recovery load on the vertical axis versus the floor area of the house.

And, as you would expect, there are variations between each house, because each house is unique in where the fixtures are located relative to the water heater and how the lines are run to reach each of those fixtures. So there is a uniqueness in each house plan.

As you would expect, the one-story houses have greater distribution loss than the two-story. With two-story your footprint is more compact, so the pipe lengths are going to be smaller and the resulting distribution losses will be smaller.

So if we consider moving away from a fixed distribution loss assumption, as is currently in place, we then have to apply the distribution loss to the end use. And the next graph then takes a look at running a linear progression through the one- and two-story points to determine what gives us the best fit for these cases, as far as distribution loss, in terms of floor area and number of stories. The bottom line would apply to two-story-or-more houses, and the upper line is one-story houses. So, again, we're seeing greater distribution loss on the one-story as the two-story.

If we go to the next slide, so what we're going to, the system that's proposed is for any house to define a standard distribution loss multiplier. And that will be a factor greater than one, and it will be applied to the fixture end use. Any point of use water heaters, as currently modeled in the ACM, would have a standard distribution loss multiplier of one. And those would be instantaneous appliances located within eight feet of all fixtures, so it would require multiple instantaneous units to achieve this point of use factor of one.

Standard one-story and two-story would have factors greater than one reflecting the distribution loss impact. This table shows for one story, a variation -- if we're looking at between 1,000- and 2500-square-foot units, the single-family would range from 1.18 to 1.33. So those are multipliers on the fixture end use. For two-story, for the same square footage range, 1,000 to 2500, the impact would be 1.07 to 1.19. So a seven to 19 percent increase for two-story.

So with this approach, all houses would have to calculate the standard distribution loss multiplier, which would be one or greater.

Now getting into recirculation systems, which are becoming more common, especially on larger houses as an alternative to multiple water heaters, the current requirements require R-4 pipe insulation on all recirculation loop piping. And what we did, we worked with the 3,080 plan, with the largest plan, and we analyzed -- it's a single-story house, and this is a project we're working on and there was a distribution, or recirc system laid out for that system, for that house by the plumber. So that was the base case that we based our calculations on.

We used concentric pipe heat loss calculations to reflect the heat loss from the pipe to a 70-degree annual average environment loss temperature. And from that, you calculate a loss per foot, which then could be converted into annual loss calculations.

The four scenarios that we looked at under recirc, one is continuous recirc, where the assumption is a 40-watt circulating pump is delivering hot water around the clock through the recirc loop. And then we looked at timer options, 16 hours per day of recirculation control, and temperature option where a sensor on the return line on the recirc activates the pump whenever the temperature falls below typically 110 degrees.

Then there's combined time temperature option where you have the timer locking out pump operation during eight hours of the day; otherwise, the temperature control is running. And finally, the demand control system, which basically is a system where by occupant control of a remote fixture, you activate a pump that brings you, it's a non-demand pumping system that brings you hot water to the fixture quickly, and more efficiently than standard recirc systems.

So now we've defined the standard distribution loss for each of these, for each house, and now we get into the variations which look at if certain measures are installed, such as recirc, pipe insulation, and we looked at two scenarios there, and the pipe insulation is on non-recirc system. So we were looking at the cost effectiveness of insulating all the kitchen, or all the lines in the house from the water heater to all the fixtures, and then looking only at the kitchen lines. Because where pipe insulation is the most effective are the fixtures where there are frequent draws, and the kitchen is clearly a place where many draws are more common.

And we looked at parallel piping, which utilizes half-inch either copper or PEX tubing, kind of in a home-run configuration, from a manifold at the water heater to each of the individual fixtures.

And parallel piping is a system which can bring you -- provides water to the fixture faster because you have smaller-diameter pipe running directly to the fixture, and it also saves water, because the volume in the lines to remote fixtures, there's less water to be wasted when you're demanding hot water, and basically you're waiting until you get the hot water before you start using it. So that was another option we looked at.

And then the recirculation controls. So these distribution system multipliers would be used to modify our standard multipliers that we previously defined, and what we found for pipe insulation, we found a .79 multiplier factor would be applied to the base case. Pipe insulation, we're proposing it should be a mandatory measure, because the -- it was found to be cost-effective to insulate those lines.

Parallel piping would have a .88 multiplier. Recirculation system, no control, we're proposing to eliminate, given the fact that all of the other control options are very cost-effective, in terms of the energy savings relative to the incremental cost.

In looking at the four control options for recirculation system, a timer control was found to have a 2.54 multiplier, so that would -- that multiplier again would be applied to the standard case.

The temperature control is slightly higher, so not quite as efficient as the timer control, time temperature of 2.09, and the demand control system would only be a ten-percent penalty beyond the standard distribution loss assumption.

SPEAKER HAMMON: Excuse me, Marc?

CONTRACTOR HOESCHELE: Yes?

SPEAKER HAMMON: Rob Hammon again. I'm unclear, when you say pipe installation, all lines and kitchen lines. Current standards, when you say pipe installation, it's three-quarter inch and larger. Is that -- Does that apply here, or is this just all lines?

CONTRACTOR HOESCHELE: This would be all lines. So if you would insulate all the lines, you would basically get a 21 percent reduction on your standard --

SPEAKER HAMMON: Regardless of diameter.

CONTRACTOR HOESCHELE: Regardless of diameter.

And so this last page summarizes where, how these multipliers get applied. And in the report, there are two equations listed, and one of them was incorrect in that the equation B on page 38 I think, the way it was configured was the distribution loss multiplier was affecting the end use, and it shouldn't be. Clearly the distribution loss impact is a separate calculation, and that applies to the entire end use and so forth.

So what we're saying, how the distribution loss gets calculated, you calculate your standard, your SDLM, as the abbreviation is, which is the graph showing the two linear regression lines. And if you have a point of use that would be equal to one, but otherwise, it's a number greater than one.

So you take that quantity minus one, and then apply any credits or recirculation penalties to that factor, so that would scale it up or down, and then that is added to one to get an overall multiplier that is then used in the second equation to adjust the end use, to give you the adjusted recovery load, which then the water heater calculations work on.

And so the final equation, standard energy use times this distribution loss multiplier, which will be greater than one, greater than or equal to one, and then the solar savings multiplier reflecting any solar thermal credit you have, in terms of solar fraction.

One investigation we did, which should be discussed some here in the forum, was to look into the -- whether parallel piping should become a prescriptive requirement or not. And we did either copper or PEX systems are available for the credit, and we did a little bit of investigating, looking into PEX, because that's where it's more commonly used.

And there are code approval issues with PEX. Some jurisdictions have approved, some haven't, and, you know, I'm not --

CBIA REP RAYMER: You struck a nerve.

CONTRACTOR HOESCHELE: Yeah.

CALBO REP TRIMBERGER: Well, that's what -- another thing the CEC and HCD attorneys will get together on that, Bob.

(Laughter.)

CBIA REP RAYMER: Actually, HCD's attorneys would love to get together with us. It's others that would be the problem. We'll talk about that in a minute.

CONTRACTOR HOESCHELE: So we looked into parallel piping. We contacted the PEX suppliers and tried to track down plumbers that are doing this. We found one. Most of the plumbers that are doing it are just using PEX as a substitute for copper. In the main and branch configurations they prefer the system.

We found one plumber who is using the home run configuration, you know, so it's hard to say that -- it's very difficult to say it's a mature market technology at this point. There is a lot of potential with the system using copper or PEX, but the data out there on cost is not clear. From this one plumber, he indicated there's a small incremental cost for going with the PEX parallel piping approach to a standard approach.

CBIA REP RAYMER: The hard costs are quite similar. It's a labor reduction. There's a 30 to 40 percent reduced labor cost in going with PEX, and therein lies the problem.

(Laughter.)

UNIDENTIFIED SPEAKER: With the copper industry?

CBIA REP RAYMER: No, not with the --

CONTRACTOR HOESCHELE: So that's basically --

CEC STAFF PENNINGTON: One of the things I'm curious about is, you know, how we avoid this PEX question, but in terms of using copper in this configuration, I'm curious to know to what extent that's cost effective.

CONTRACTOR HOESCHELE: Yeah, and we

should look at that in a little more detail. I don't know, I talked with Dave Springer, president of DG yesterday about that issue and, you know, we don't know. And, Bob, I don't know if you know how much copper parallel piping is going on, and we're not really aware of --

CALBO REP TRIMBERGER: Zero.

CONTRACTOR HOESCHELE: Zero?

CALBO REP TRIMBERGER: Zero.

CONTRACTOR HOESCHELE: Okay.

CALBO REP TRIMBERGER: Tom Trimberger from CALBO. In Sacramento County we do a great deal, half to a third of all tract homes are done with PEX. And of those, probably 90 to 95 percent are parallel.

CONTRACTOR HOESCHELE: Parallel?

CALBO REP TRIMBERGER: Yes, absolutely.

CONTRACTOR HOESCHELE: Home run --

CALBO REP TRIMBERGER: No, somebody will run it once or twice as a conventional system and then they'll run it parallel.

CONTRACTOR ELEY: You said 90 percent?

CEC STAFF PENNINGTON: And why is that --

CALBO REP TRIMBERGER: And that market

is developing and growing.

CEC STAFF PENNINGTON: Why are they choosing -- I'm going to talk to Tom first, here. Why are they choosing to do that?

CALBO REP TRIMBERGER: To run parallel?

CEC STAFF PENNINGTON: Yeah.

CALBO REP TRIMBERGER: It's easier to run half-inch runs to everything, run to an interior manifold. The product is easy to install, and it cuts down the number of fittings. It makes kind of a little spaghetti pattern, if you're not used to looking at it, compared to conventional plumbing, but it's just too easy.

CEC STAFF PENNINGTON: I guess one question I would pose for both of you is, you know, if we determined that it was cost effective to do copper piping in a parallel piping configuration, would that be an issue to have the standard based on that configuration?

CBIA REP RAYMER: I'm going to have to see the numbers, but since copper is hugely labor-intensive, that's the bulk of the cost. If I could take a step back and just --

CEC STAFF PENNINGTON: So that's a -- generally no if we found --

CBIA REP RAYMER: I suspect that you're not going to find that to be the case.

But I don't want to leave the wrong impression about the state of California PEX right now. This morning on my way over here I picked up the, like, third set of 15-day language for the adoption of the Plumbing Code. And the two issues are over corrugated stainless steel tubing and cross-link polyethylene PEX.

But right now, just like we've seen for the last couple of weeks, HCD and the Building Standards Commission, it looks like next week they'll approve the use of CSST. They will stay silent on the Uniform Plumbing Code's allowance for PEX. The national code, the 2000 edition of the UPC would allow cross-link polyethylene.

It cites that the state of California is going to cross out that sentence. That does not mean the state of California is prohibiting it, it simply means that when the 2001 Plumbing Code comes on line November 1st or a little bit after that, that local jurisdictions -- it will be entirely up to the local jurisdiction to say yea or nay for PEX piping.

And I think there will be another

similar fight to this in the 2004 adoption, but, I mean, that's down the line. Right now it's entirely up to the local jurisdiction. In places like Rocklin they love PEX, there are jurisdictions all over the state where they love that. But you'll also have some jurisdictions that will very quickly take action not to allow PEX. And this has very little to do with the product itself.

WORKSHOP CHAIR ALCORN: Okay. Recognize Larry Acker.

SPEAKER ACKER: Larry Acker, Advanced Conservation Technology. I've got a couple of questions I'd like to ask, maybe a clarification on the manifold-type systems. I think what he's referring to is a little different than what you're actually referring to in your parameters that you laid out.

You referred to three-eighths-inch manifold being at the water heater; am I correct?

CONTRACTOR HOESCHELE: Well, we ended up running half-inch -- I mean, the parallel piping cases are based on half-inch, but yeah, with the manifold at the water heater.

SPEAKER ACKER: At the water heater?

CONTRACTOR HOESCHELE: Yes.

SPEAKER ACKER: Is that where the manifold is?

CALBO REP TRIMBERGER: Or close.

SPEAKER ACKER: Because I believe I've seen the houses that he's referring to, and the manifold is towards the back of the house where your short runs are to the fixtures.

There is another issue here that we see, and that is how much water can actually, is acceptable to be lost? We know losing water also costs energy. If you have incoming water supply costs and you have outgoing water supply costs, those are energy costs that are related to incoming pumping and outgoing sewage processing.

Probably the most important that I see, cities are starting to mandate water saving issues, and those issues are now becoming circulating type systems. And I have yet to see an area where I think the question is, do we see areas where the customer is really satisfied or the city, where the issue is important, is that an issue. Running that water down the drain is still going to occur with parallel piping. How much water is acceptable?

Is it going to be a quart, half a gallon, a gallon? And are we talking about three-eighths-inch or half-inch? I think that determines also the amount of water that's going to go down the drain, and where is that manifold going to be placed? So there are a number of issues that I see with parallel piping.

Same issues I see with temperature timers. On the temperature timer area, your basic aqua stats are set right now from the manufacturers at 95 to 115 degrees. Now, they can be set at any temperature; however, they're accurate within five or ten percent, and I think your parameters lay it out to 135 degrees with approximately a 20-degree differential. So there could be some --

I've talked to a number of manufacturers. I've spent a lot of time with water heater manufacturers, pump manufacturers, spent a lot of time with builders on the project. And I see some issues that we have to look at, is the consumer willing to accept what we're willing to do? Because if they don't accept it, then we have a different kind of a problem to begin with. We have to be sure the consumer accepts it, the builder accepts it, and the codes are, in fact, energy efficient in one form or another.

WORKSHOP CHAIR ALCORN: Bill?

SPEAKER MATTINSON: I just have a couple of questions for Marc, and, again, this is -- I guess these are -- coming from my experience dealing with builders, designers as an energy consultant, looking at the current ACM assumptions, surprisingly, ever since we've had them for the last ten years, I had been surprised at how little ahead recirc took when you had a temperature or a timer, or when you had a timer and temperature controller you got a credit.

I'm assuming that, like going from .96 for that to the new value which is I think 2.09, reflects better calculations. I mean, that the old stuff was all in error. We've now doubled the penalty for recirc. Is that --

CONTRACTOR HOESCHELE: Well, that's a good question, because we were trying to track down the source of the original recirc numbers, and --

SPEAKER MATTINSON: I didn't know.

CONTRACTOR HOESCHELE: No, I know. I mean, it's --

SPEAKER MATTINSON: But that is the impact, that the penalty for recirc -- I mean, there is a penalty for recirc now that just about doubles the use, whereas before it was almost neutral.

CONTRACTOR HOESCHELE: Yeah, I think those were not accurate, the prior numbers.

SPEAKER MATTINSON: Okay.

WORKSHOP CHAIR ALCORN: Gary?

CEC STAFF KLEIN: Yes, thank you. My name is Gary Klein. I work for the California Energy Commission. I was asked to spend some time reviewing this paper because of my interest in this area, and I have a couple of questions and comments, I'm confused about a couple of items. So I'll just sort of go through them.

I want to reiterate something that Mr. Acker just talked about, having to do with how much water loss is acceptable. And that relates to how much time people are willing to wait to get hot water at a fixture before they start to complain. And so I'm curious to understand how much water is being lost on the way before it's getting used as hot water, in each of the configurations as described.

One of the things that's assumed in the model that's discussed here is that if you're within eight feet of the fixture with a half-inch diameter pipe, the water loss is negligible, and that's sort of our acceptable number, if I'm understanding correctly; is that about right, Marc?

CONTRACTOR HOESCHELE: Well, that's what we're computing the recirc credits or multipliers.

CEC STAFF KLEIN: Right.

CONTRACTOR HOESCHELE: We're saying the recirc loop has to be within eight feet of each fixture.

CEC STAFF KLEIN: With a half-inch pipe, probably.

CONTRACTOR HOESCHELE: Probably, yeah.

CEC STAFF KLEIN: I know we haven't stated that, but I'm assuming that's about it. So a half-inch diameter pipe, I'm assuming again copper for the moment, because that's what the base seem to be on, has a certain amount of water in it.

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: About a cup or so, I

don't know what the exact number is -- somewhere between that and a pint, but there's a certain amount of water.

Well, if you have a properly designed recirculating loop that serves all the fixtures in the house, then you've got effectively a loss of no more than eight feet of pipe, or whatever that volume is, per fixture per use, right? How is that going to be more water consumed waiting for water than a parallel piping system which is going to have a lot more than eight feet to deliver the water from the water heater to that point? There's going to be a lot more water. The average pipe length in that case is probably 20, 30 feet.

In my house the longest distance would be almost 75 or 80 feet of pipe. And in the 3,000 square foot example one the long runs was, well, they were pushing 80 or 90 feet of actual pipe length was going to be in there. That's a lot more water loss than in the eight -- the recirc case where there's only eight feet of water that's not warm.

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: Okay, so I'm unclear as to whether or not we're accounting for the math correctly in terms of the benefit of a well-designed research system versus a well-designed parallel piping system, in terms of how much water is wasted and, therefore, how much energy has to be used to heat that water, delivering the water to the fixture in any of the cases. Parallel piping is the one that concerns the most, but even in the standard plumbing case, we --

I'm not convinced that the model that Hot Water Sim uses has the right mathematics to cover the case of bringing the water from the fixture to the -- from the water heater to the fixture prior to its use. And so I have some questions about that part of the model that I'm confused about. I've read it a couple of times and I'm not convinced it's doing the math right.

CONTRACTOR ELEY: Well, you didn't use HW Sim for recirc.

CONTRACTOR HOESCHELE: Not for recirc, no, but for --

CEC STAFF KLEIN: I understand you didn't use it for recirc.

CONTRACTOR HOESCHELE: I mean, for parallel piping, the program works the same. I mean, you're given a length of pipe and a diameter, and the program makes a decision, depending on what kind of usage it is, whether the water is of acceptable quality, basically the 105 degrees for most uses or not.

CEC STAFF KLEIN: Right.

CONTRACTOR HOESCHELE: If not, it's thrown away, and --

CEC STAFF KLEIN: And it's all the way back to the water heater.

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: What's interesting to note is that it looks to me like if you insulate the pipes -- I want to talk about how the plumbing in this house works. The water heater heats the water, right? We agree that that happens. And then there is a distance to the fixture, and the fixture uses water when you use it; is that right?

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: In the model, once I start drawing water, do I start accumulating line losses, or do I only accumulate line losses after I've started using water for my real use?

CONTRACTOR HOESCHELE: Well, line losses, whether they exist or not, are dependent on the previous draw pattern.

CEC STAFF KLEIN: Right.

CONTRACTOR HOESCHELE: And in a conventional --

CEC STAFF KLEIN: Well, forget the previous draw. Let's start out 6:00 o'clock in the morning on my first draw of the day, I want to understand that one.

CONTRACTOR HOESCHELE: Okay. Then all the water is thrown away in the line.

CEC STAFF KLEIN: Because it's too cold.

CONTRACTOR HOESCHELE: It's too cold.

CEC STAFF KLEIN: And I looked at one of the studies, the parallel piping study, it showed a decay rate of uninsulated pipes and some insulated pipe. And in all cases for uninsulated pipe, regardless of the diameter, in less than six minutes the temperature was below 105 in that line.

So unless the use was within six minutes it's a cold start and you've got to run the entire line out.

CONTRACTOR HOESCHELE: Okay.

CEC STAFF KLEIN: Okay. That's what I think the math should say. So I've got to run that whole line back out. So it seems to me that I have the use, three minutes for my shower, five minutes, whatever it is, that's how much I'm using when I actually want the draw, and that's what the draw schedule was about, the water used during the use period.

And then on top of that, there is the energy used to get the water from the water heater to that fixture. And that should be additive, wouldn't you agree? That if I've got a certain amount of energy in my use and I've got a certain amount of energy to get the water hot enough to be useful.

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: They should be additive, right?

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: I'm not convinced the model adds them. It appears to subtract them, and I'm confused. I could be very wrong, maybe it's just a typographical error. But what I'm reading in the documents doesn't appear to make them additive, it appears to make them subtractive.

So I'm admitting to confusion here, but if I'm correct, then there's something pretty bad in the way it's calculating. And it's underestimating the energy cost to bring hot water to fixtures.

And so I know in my last house I -- the first house I lived in, before the one I'm in now, I tested how long it took for the first draw to bring me hot water. It took almost four minutes for me to get in that shower. And I measured the water and it was over four gallons of water that had run down the drain.

Now, there's a couple of observations here. The volume of water in that 70 feet of pipe was a lot less than a gallon, or just about a gallon. So I'm wasting two, three, four times as much water as was in the pipe, bringing the hot water.

COMMISSIONER ROSENFELD: And that's because you're heating up the pipe slowly.

CEC STAFF KLEIN: I'm heating up the pipe slowly, yeah. And so, again, I'm not seeing that in the mathematics. It doesn't appear to -- I mean, that's a big number. If I take a three-minute shower at a gallon of water a minute, a five-minute shower, I'm using almost as much water -- wasting as much water as I actually used in my shower pattern. Whoops, that's a lot of water.

So I'm confused as to -- I'm not worried about the nth, period. I just want to figure out the first one in the morning. I don't see the mathematics sorting out right.

CONTRACTOR HOESCHELE: Well, one limitation of HW Sim, which we can, you know, address within the scope of this, I mean, clearly with all -- there is a lot of field research and so forth that can be done to better understand a lot of systems, conventional systems and alternative systems. But the way the program is configured, it works with annual loss conditions. You have a hot water temperature and you have a loss environment.

You know, ideally you'd like to vary that seasonally, and it's currently not with the limitations --

CEC STAFF KLEIN: Even the average for the year would be great, to understand the problem. But it's -- I'm confused about how it's doing its math.

Another comment that I see from the numbers that we're proposing here for the distribution system multipliers, is that the .79 or the .88 for -- .79 or the mandatory measure for the insulating of the lines is really only -- if I understand the model correctly, is really only looking after you've used hot water. Because that's when that part of the model seems to kick in.

And it changes into K rate, so that the water stays warmer in the line longer, and the next use shows up that I don't have any delivery costs anymore because I've got warm water.

CONTRACTOR HOESCHELE: If it's close enough in time.

CEC STAFF KLEIN: Yes, and it turns out that's within an hour, according to the math, for a three-quarter-inch line.

Again, I'm looking at what was shown in the reports that were provided for this document. And it may not be exactly an hour, because I don't actually think the water gets from the water heater to the fixture at 135 degrees. I don't think it ever arrives that hot, it arrives at some lower temperature, so I've probably got 40 minutes of time.

Well, a lot of the pattern in the

schedule and one of the reasons it would appear that the kitchen-only line is so cost effective is that once you start your dinner hour, you're pretty much drawing water every 30 to 50 minutes for the next three hours in that part of the house. And if you're doing that, you're always going to maintain temperatures that are warm enough in the line for use, and the line never degrades to below the proper point.

But it's only covering the case, initially it covers the case of the loss, the decay after the use, and then as long as the next use is within that decay period, you're not drawing any new hot water or creating any new losses or waste out of the system. So it's giving a huge benefit at the back end of the system at the beginning of the day, and then after that it's during the periods.

And my analysis of the draw schedule, insulating the lines makes a huge difference and is a very good credit to want to have. It looked to me like it probably ought to be almost for every line, because the decay rate for every system, regardless of whether you put a recirc loop on it or you just want to have people have better hot water service, seemed to be worthwhile. So I'd want to encourage more of that rather than just a kitchen-only line.

CONTRACTOR HOESCHELE: Well, we evaluated that, though, and we couldn't justify that.

CEC STAFF KLEIN: You couldn't justify that, okay. And it's because of the cost of all the lines.

Are you expecting that parallel piping lines are going to be insulated?

CONTRACTOR HOESCHELE: That's not the assumption, no.

CEC STAFF KLEIN: Okay. Why wouldn't they benefit from the same thing?

CONTRACTOR HOESCHELE: Well, they could. That wasn't looked at. I mean, typically they're not. That's a variation we could look at.

CEC STAFF KLEIN: Okay. Going through the tables, I found a couple of minor things -- Maybe they were intentional, maybe they were unintentional edits. I'm on page 36 of the report, looking at table 17.

You've identified a bunch of houses that are being evaluated.

CONTRACTOR HOESCHELE: Right.

CEC STAFF KLEIN: This table appears to have left out the 1200-square-foot house.

CONTRACTOR HOESCHELE: Okay.

CEC STAFF KLEIN: Again, I don't know if it was intentional or not, I'm just pointing out some things I found in my read.

CONTRACTOR HOESCHELE: Yeah. And there is a typo in that table too, for the 3,080-foot case, the half-inch length should be 125 feet.

CEC STAFF KLEIN: Based on -- I thought that from the diagram of the 3,000-square-foot house that there was a lot more three-quarter-inch pipe and one-inch pipe than that as well.

CONTRACTOR HOESCHELE: For the recirc system, or -- This is the standard.

CEC STAFF KLEIN: This is the standard?

CONTRACTOR HOESCHELE: Yes.

CEC STAFF KLEIN: Okay. Just to get to the kitchen in that house, because of the draw on it, you're going to have a lot more than a combined 48 feet of pipe. The three-quarter-inch pipe looks very low to me.

CONTRACTOR HOESCHELE: The 30 feet?

CEC STAFF KLEIN: Yes, in that same --

in that house.

CONTRACTOR HOESCHELE: That's an actual takeoff of the plumbing that was done in that house.

CEC STAFF KLEIN: So there's a -- Okay. It just seems awfully low, based on the way the house was laid out, but I'll believe that that's accurate, I just -- it seems exceedingly low. But the number for the 72 should be what, 170?

CONTRACTOR HOESCHELE: 125.

CEC STAFF KLEIN: Okay. I'm looking at the figure eight, and you point out an anomaly in figure eight, saying that the recovery efficiency of the 2,000-square-foot house and the 3,000-square-foot house are essentially the same.

CONTRACTOR HOESCHELE: The --

CEC STAFF KLEIN: The 2,010 and the 3,080.

CONTRACTOR HOESCHELE: Okay.

CEC STAFF KLEIN: And then it looks to me that we then had a regression analysis for two stories and one story, and I'm unclear how you got such a wonderful regression line with data that does that. It seems like that last house really skews the line down, and, in fact, it looks like the regression, if you did it without the 3,000-square-foot house, would be a steeper line.

CONTRACTOR HOESCHELE: Well, I think they're fitted through zero at the other end, so --

CEC STAFF KLEIN: I'm just -- It's an observation. It doesn't seem quite right.

WORKSHOP CHAIR ALCORN: Gary, can I interrupt for a moment?

CEC STAFF KLEIN: Please.

WORKSHOP CHAIR ALCORN: And ask, are the remaining comments editorial in nature? If they are, you know, we can take the comments and incorporate them.

CEC STAFF KLEIN: I have those types of comments and I'll save those for a later point.

WORKSHOP CHAIR ALCORN: Okay. That would be useful because we have kind of a time constraint.

CEC STAFF KLEIN: I understand that.

It seems to me that the major issue for the Commission is to -- in this round of standards is to pay attention to what the cities around the state are beginning to do in terms of water. They want to do things because they think they need to save lots of water in homes, and they're beginning to mandate certain types of solutions.

What customers seem to want in hot water is they'd like as much as they want when they want to use it, and they'd prefer to have it now, without any wait. And so many consumers also don't want to waste water because they pay for it and they don't want to see it run down the drain, and there's a bunch of that environmental stuff going on as well.

The cities are beginning to mandate things that would -- if you put in -- they're mandating research systems to save water. And I'm pretty certain that a well-designed research system will save a lot more water than a parallel piping system in the same sized house, just based on the obvious lengths of pipe that have to run down to the fixture.

And if that's true, and we do something as a Commission to say, well, we're going to prescribe parallel piping, then the cities are prohibited from saving water. And I'm not sure that we ought to make that choice. I think we ought to allow the best choice from the consumer's point of view, which is to get as much hot water as they can get, as much as they want to use it. I realize we'd like that to be very efficient, but we'd like to do it with a minimal waste of water.

CEC STAFF PENNINGTON: You recognize that a prescriptive standard is not a mandatory standard.

CEC STAFF KLEIN: I understand that.

CEC STAFF PENNINGTON: So I don't understand how a prescriptive standard precludes --

CEC STAFF KLEIN: What does it do? If it's prescribed --

CEC STAFF PENNINGTON: It sets an energy standard, an energy budget, basically, so --

CEC STAFF KLEIN: Okay.

CEC STAFF PENNINGTON: -- you're not ruling out the other system at all.

CEC STAFF KLEIN: Fair enough. I'll accept the distinction.

I mean, you're seeing a fair amount of it, the fellow from CALBO was saying a fair amount of those parallel piping systems are being installed in Sacramento County. Are customers happy with that as a set of choices, from a service point of view or an energy point of view? Have you found anything out?

CALBO REP TRIMBERGER: They've been working well, haven't had any unsatisfactory feedback.

CBIA REP RAYMER: They're using PEX on that, right?

CALBO REP TRIMBERGER: Yes, they are.

CEC STAFF KLEIN: That's fine. I'm just curious about that.

SPEAKER MATTINSON: Gary, they're not comparing it to recirc, though. I mean, the other is just the conventional traditional system, which they wait a lot longer to get hot water and they run a lot more down the drain. So comparing the parallel to what their alternative was, because the recirc systems, other than in jurisdictions that have mandated it for water conservation, have been in high-end luxury homes, for the most part. So I think these are two different animals here.

CEC STAFF KLEIN: They could be.

I realize that the pipe length is much -- the pipe diameter and, therefore, the volume is much greater in a conventional one for the same distance to the fixture. But if we follow what we're supposed to do in the parallel piping systems, provide half-inch to -- if you provide half-inch to the shower in the master bath and half-inch to the two sinks in the master bath, are you supposed to provide one to each sink, or are you allowed to split for those two?

And if you split them, you get real good benefits for both sinks, but if you don't, and I come in in the morning and shave and shower at one sink and my wife comes in and uses the other sink, she's got to wait just as long to bring hot water. And all of a sudden the standard system looks better in its delivery capability. Because the use is within ten or fifteen minutes and it might not be any less -- more cold water out of the system and things like that.

So all of a sudden, parallel piping on its own, compared to insulated standard piping, may not be as good.

CONTRACTOR SPRINGER: Dave Springer, Davis Energy Group. Gary, if you go to the tables of the Uniform Plumbing Code, you know, it would allow for two lavatories, a single half-inch pipe to be shared.

CEC STAFF KLEIN: But not the shower.

CONTRACTOR SPRINGER: Not the shower.

CEC STAFF KLEIN: Okay. So I take a shower and the water runs down the drain for the shower, and then I get out and I want to shave, so I do that at the sink. I have to run the water out of that one all the way back.

So in a standard plumbing case, I would have had that line already hot.

CONTRACTOR SPRINGER: Yeah. You know, unfortunately it wasn't in our mandate, it's understandable that we want to reduce water waste. That wasn't in our mandate. We can't lump that in with the energy standards review. And what is also isn't in our mandate is determining waiting times.

CEC STAFF KLEIN: But our mathematics and the ways we pick the numbers for benefits will ultimately reflect on that answer in the real world. If we say this is the credit such a system gets, it implies certain wait times, water use, etc. And if those are not appropriate numbers from the public policy point of view, then we're frustrating actions of other folks who have a right to do their mandates. And our standards are in conflict with them, and I'm not certain that's what we're intending to do.

I'm agreeing that your mandate wasn't to do some of this stuff.

CONTRACTOR SPRINGER: Yeah. Just one point on parallel piping. We have measured waiting times in homes with parallel piping, and they're generally very short. You know, with very, very large houses that are very spread out, it doesn't make sense from the standpoint of water comfort and quality to do a parallel piping system, but for smaller, more compact houses it does make sense.

And I don't know if we can mandate that in the standards or not, but --

CEC STAFF KLEIN: My last observation, Bryan, and then I'll stop on this, is that it seems to me that a well-insulated standard plumbing system might, in fact, be a better choice -- it appears that a completely well-insulated, better well-insulated plumbing system, branch and mains, would be better than a parallel piping system, in comparison as a base for the standard.

Because the retention -- Because of the way the use patterns are likely to be, and if they follow our own use patterns, most of the uses on each of the branches in the system happens very, very quickly, within an hour of each other in the morning cycle and within an hour or so of each other in the evening cycle. And there's very little use in most cases during the day, and when there is, there's uses that are fairly close together.

And so a well-insulated standard main system may, in fact, prove to be a better base for a standard than the parallel piping.

CONTRACTOR SPRINGER: Well, where that falls down is, you know, you have a decay constant for an insulated pipe too. And if the waiting time between uses is such that the water has dropped below that 105-degree point, the insulation has no value. And that's what we're finding in our work.

CEC STAFF KLEIN: Yeah, I'm not disputing that. Thank you.

WORKSHOP CHAIR ALCORN: Thank you, Gary.

Noah Horowitz has a comment, and we've got some other people waiting in the back of the room.

NRDC REP HOROWITZ: Noah Horowitz, NRDC. Big picture, to oversimplify this again. I understand we're looking at improving the multipliers and the modeling, so it more truly reflects what's going on out there. And we want to tweak the insulation requirement for credit.

What I want to get a better understanding is, by making these modeling changes, at the end of the day are we going to result in energy savings or not? And what's the magnitude of the savings?

CONTRACTOR ELEY: The answer to that in part depends on whether parallel piping becomes the prescriptive basis for the standard; otherwise, I think we're just making more fair and equitable tradeoffs.

NRDC REP HOROWITZ: And I haven't read through your analysis. If we do go to the parallel piping, do we have a ballpark number of what that might save us?

CONTRACTOR HOESCHELE: Well, we're talking 12 percent of distribution loss, so 12 percent of 20 therms. So it's not -- I mean, 15 to 30 or 35 therms, and you look at the full size range, so three to five therms per year.

NRDC REP HOROWITZ: One of the reasons I'm asking the question is as we dive into all these details, I just want to know is it worth putting a lot of attention, what's the relative energy savings, and I haven't heard that discussed.

CEC STAFF KLEIN: So we're talking about, like, three dollars a year or something in current costs. I just want to know what the magnitude is.

PG&E REP STONE: I came up here --

WORKSHOP CHAIR ALCORN: Nehemiah, before you make your comments, we have -- we're significantly behind schedule, on the order of a half an hour, and so if the remaining comments could be kept to a minute or two, that would be great.

PG&E REP STONE: Nehemiah Stone, HMG, representing Pacific Gas and Electric.

I came up to respond to two comments, or two issues on Gary's and Noah brought up one that's very related. And that is that anytime we make a change it gets more accurate on how we're representing something. We're saving energy. Because without being accurate, people are getting the wrong messages and they're putting it -- they're being able to trade off things that actually would save energy for these things where there's bogus credits or vice versa. So anytime we do that, we may not be able to quantify exactly how much, but we are moving towards energy efficiency.

Secondly, there are a number of studies by Fred Goldner and by Mary Lobenstein that indicate that although we all know you want hot water immediately, as soon as you turn on the tap, that our -- the level of our desire for that doesn't turn into the point of where it's an issue until a lot farther along than most of us would think.

And so if there is some delay in getting the water there, and that delay has -- relates to water going down the drain, that's a separate issue. But I think we need to not put as much emphasis in the fact that customers are going to be unhappy if the water isn't there right away. Because studies show that it's just not that big an issue until there's a really significant delay.

And the kinds of things that Marc analyzed don't incur those significant delays.

WORKSHOP CHAIR ALCORN: Thank you.

Elaine?

CEC STAFF HEBERT: Hi, I'm Elaine Hebert with the Energy Commission. And somewhere along the line in various meetings that I attend I heard an idea that I just want to throw out on the table, and I will ask if there has been any modeling or analysis on this idea. And that is to plumb the house for only cold water. No central water heater. You run only cold water pipes, and you have an on-demand water heater at every point in the house where you need hot water.

And I don't know -- I heard this idea, I don't know if anybody has pursued it or modeled or anything like that, but it eliminates a bunch of labor for running pipes, it eliminates a bunch of pipes, and I don't know what the cost is, you know, versus -- many little water heaters versus one central one. Anyway, just a thought.

If anybody has any further information on that, I'd be interested in knowing about that.

WORKSHOP CHAIR ALCORN: Thank you, Elaine.

COMMISSIONER ROSENFELD: I have a comment. Since some cities are interested in saving water, and I'm also slightly disturbed -- I mean, if there is a plus sign instead of a minus sign, we ought to get it right. I mean, would it make sense to extend this study slightly and at least produce one more column on this table, which is the number of gallons dumped, or the percentage is the way you word it, for these hypotheses?

Because it seems like you've done a good job and it would be useful to other communities and jurisdictions if we just knew how much modeling -- you know, you've sort of done 95 percent of the job, and your program knows how much water was dumped, so it would be useful.

And then the last thing is just could you guys get together at, say, using, where was it the four gallons wasted or something and see if, for that particular design, the simulation program actually checks out. I mean, I would feel better if there was not a minus sign in a program which we're relying about.

CEC STAFF PENNINGTON: Okay. We'll do that, Commissioner.

CALBO REP TRIMBERGER: Bryan, I don't want to take a lot of time either. Just looking at page 41, it talks about the parallel piping issues. There is certainly a lot of debate in the plumbing industry without me jumping in a whole lot.

Three-eighth-inch pipelines are not in the UPC, so I'm not sure what they're talking about acceptable, I'm not sure how that is taken into effect. Also, they talked about parallel piping credit for lines no longer than half-inch. Some of the projects I'm seeing are running a three-quarter-inch to a tub, especially a jacuzzi tub, where, you know, for a standard shower head and lav, you've got a flow restrictor at a half GPM anyway, but you don't for the tub, so a lot of those are going larger.

That's a little bit more info.

WORKSHOP CHAIR ALCORN: Thank you, Tom.

Ahmed?

CONTRACTOR AHMED: A. Y. Ahmed, consultant to Southern California Gas.

I just wanted to understand, Marc, basically the HW Sim model, you took the annual budget and then translated that to draws, right? You sort of worked from the budget backwards to the draws?

CONTRACTOR HOESCHELE: Right.

CONTRACTOR AHMED: Okay. And then the other thing is that these draws, the table that you have for the draws, are you assuming they're all sequential, or there are some simultaneous draws?

CONTRACTOR HOESCHELE: There are no simultaneous draws --

CONTRACTOR AHMED: They are all sequential.

CONTRACTOR HOESCHELE: -- because the program can't handle that.

CONTRACTOR AHMED: Okay.

CONTRACTOR HOESCHELE: They can't overlap.

CONTRACTOR AHMED: All right. So if they are sequential and if there is a lot of time in between, then it will show a lot more wasted water.

CONTRACTOR HOESCHELE: Right.

CONTRACTOR AHMED: And a lot more use of energy, versus if they were grouped together. I just want to understand how it is done, and so that, you know, the questions that Mr. Klein asked, some of those questions could be answered if you could explain how the draws were done, and what the model really predicts.

CONTRACTOR HOESCHELE: Well, the report includes a typical profile of a full week of how the draws are interspersed.

CONTRACTOR AHMED: Right, but the time between the draws are not -- you know, we don't know about that.

CONTRACTOR HOESCHELE: Okay.

CONTRACTOR AHMED: So if you have a table to show that, that I think should answer a lot of questions.

CONTRACTOR HOESCHELE: Okay.

CONTRACTOR AHMED: Regarding losses and water wastage.

COMMISSIONER ROSENFELD: If I can make my comment again. Again, I think you guys have done most of the work, but some time series for a few hours of the day or something, showing how much you actually use at the tap and how much you dump and it's just some graphics. Some graphics would I think help explain to us a lot of some good work that you've done.

CONTRACTOR HOESCHELE: I don't know if the program can tabulate -- it does tabulate total water wasted, but on a per-draw basis, I don't think that kind of information is --

COMMISSIONER ROSENFELD: We should look. I mean, somehow or other, down in the program it must know.

CONTRACTOR HOESCHELE: Yes.

CONTRACTOR AHMED: One other thing I wanted to point out is that it also will depend which fixtures and which branches the draws are occurring. If they are occurring in different branches, there is more water loss than if they were in the same branch. So those are the kind of issues that you might like to look into.

Thank you.

WORKSHOP CHAIR ALCORN: Thank you, Ahmed.

SPEAKER HAMMON: Real quick?

WORKSHOP CHAIR ALCORN: Okay, Rob Hammon.

SPEAKER HAMMON: Thanks, Bryan. Just real quick, at the risk of doing something I asked people not to do last time, which was thrown in anecdotal information, I'm just curious about the effect of the R-4 insulation.

Some anecdotal information from my house and some others that I've talked to, if we think that it's going to take -- that the water is going to stay warm in the pipe for 30 minutes, if the pipe is insulated, I suspect that's not true. Due to installation problems, like we find in the other parts of construction, I know in my house I insulated every pipe in my house as it was being built, and my water goes cold in five or six minutes.

CEC STAFF KLEIN: Which says it's not insulated, according to the map.

CEC STAFF PENNINGTON: Well, it's the quality control.

(Laughter.)

SPEAKER HAMMON: This was before I knew what I was doing.

At any rate, I'm just wondering if there have been any field measurements on the impact of insulation in the field, compared to per the model.

CONTRACTOR HOESCHELE: No, not what we have.

SPEAKER HAMMON: Okay. Because I suspected that the actual impact is substantially different from the theoretical.

CONTRACTOR HOESCHELE: No, I agree, and

certainly there are places to improve the assumptions in the model.

WORKSHOP CHAIR ALCORN: Great. Thank you all for this discussion. We're going to go ahead and take a lunch break now.

If we could be back by, well, 1:45 is kind of pushing it, but 1:50, that would be great. That gives us about 40 minutes for lunch.

(Thereupon, the luncheon recess was held off the record.)

--oOo--

A F T E R N O O N   S E S S I O N

WORKSHOP CHAIR ALCORN: If I can have everyone's attention, we're going to go ahead and start right up with the second half of the workshop.

Mark Hydeman is going to be presenting on the Demand Control Ventilation topic, and I think the Powerpoint presentation is ready.

CONTRACTOR HYDEMAN: Okay. I'm going to be talking about demand control ventilation. Demand control ventilation, there is an existing requirement in section 121-C-3 for demand control ventilation. I'll show you elements of that requirement.

I guess I should introduce myself. I'm Mark Hydeman with Taylor Engineering. I'm one of the consultants to the California Energy Commission staff on development of the requirements for the 2005 standard.

The DCV study scope includes, we're looking at expanding -- extending some of the occupancies, and I'll show you a side-by-side comparison on that issue in a moment. We're looking at the system size limit threshold; in other words, the size of an air conditioning system for which demand control ventilation would be required.

Then there's two issues that are almost more maintenance issues. One is the control threshold for CO_2-based demand control ventilation sensors. Presently it's at 800 parts per million and we have gathered some data to try and revise that. And finally, we're adding some design and verification requirements to make sure that these systems, when installed, do operate as intended.

This is a comparison side by side of the existing and proposed requirements. The important things are in blue here. I'll call your attention to the left-hand column there. The existing requirement is set for spaces that either have fixed seating or a designed occupant density of less than or equal to ten square foot per person, or that are identified in chapter ten of the UBC as assembly areas, concentrated use.

The proposed requirement, based on life cycle cost analysis which I'll get into in a moment, is on the right-hand side under item B, and that is we've gone from ten square foot per person, which are generally very high-density assembly areas, down to 40 square foot per person, which is the classification for classrooms. And you can see there's quite a number of UBC assemblies, where spaces that are now included, it's assembly areas both concentrated use and less concentrated use -- auction rooms and classrooms are all covered under the new requirement.

The other area, as I mentioned earlier,

was the size of the unit or the threshold of the unit. It used to be that any unit that had an outdoor air design capacity of 3,000 CFM or greater were required -- that's the present requirement -- were required to have demand control ventilation. The proposed requirement is any unit that has an outdoor air economizer, and we'll get into why that's the case in just a moment.

This is continuing with the comparison of the existing language and the new language. The existing language states that the demand control ventilation device can reduce the outside air down to .15 CFM per square foot. This is the other value from table 1-F of the standard, and the intention of having a floor there is to make sure that you get rid of the building-borne contaminants, the outgassing of volatile organic compounds, mastics and other such things.

The second thing is that it's broader than CO2 sensors, it's really any sensor that's approved by the Commission. And then the third item that I mentioned earlier is if it is a CO2 sensor, that they must control the carbon dioxide levels to no more than 800 parts per million. And as I will show in a moment, that's actually quite, provides a quite higher ventilation rate than 15 CFM per person, so it's inconsistent with other areas of the standard.

This is the proposed requirement, the proposed requirement is that we will accept only CO2 sensors. This is because the CO2 sensors are the only demand control ventilation device for which -- it can be shown that they reasonably estimate the occupancy, that CO2 is an excellent proxy for the number of people in the space. And for which you can have a definable threshold or set point that is representative of the ventilation rate per person.

And furthermore, we're putting some performance requirements on the CO2 sensor, to make sure that you have accuracy of less than or equal to 75 parts per million, that the sensor is factory calibrated or calibrated at startup, and that it requires calibration no more frequently than once every five years. And there are multiple manufacturers of sensors that meet this requirement. We've actually done a survey -- It didn't end up in the report, but it will be in the next draft of the report -- that documents the manufacturers that can meet these requirements.

And furthermore, we're taking some of the recommendations that have come out of the research and design community as to where that sensor should be located. It's not acceptable to put it in the return air, but you want that sensor located in the space.

The floor has been changed from .15 CFM per square foot to equation 1X -- Oh, sorry, I jumped down to item C. Item B is that the way that sensor shall operate is to reduce the ventilation rates such that you have the equivalent of 15 CFM per person at all times, and that's covered in equation 1X, which is the next slide that we'll get to. So we're equating parts per million of CO2 to the ventilation rate of 15 CFM per person, and we're providing defaults for how that's calculated.

Item C covers the floor. It used to be .15 CFM per square foot, but now we're using the table 1-F values, and the table 1-F values are there, they're .15 CFM per square foot for most occupancies. But in a couple of occupancies they're higher, and that's because it's expected in those occupancies that there are other unusual sources of contaminants, for which you want to make sure that you have adequate ventilation.

And the table 1-F values really represent building-borne contaminants, or contaminants that are associated with a space use that wouldn't otherwise be detected by a CO_2 sensor. And finally, there's another performance requirement, and that is that the sensor and controller will default back to the designed outdoor ventilation rate when the sensor is detected, or has self-detected that it's out of calibration. So it's kind of a provision to protect the space.

Here is the equation 1X. It's a rather nasty little equation that steady state assumes that people give off CO_2 in relation to their activity or met level -- That's the top part of the equation in the numerator there. The 8400 is a conversion factor for units. M is the met level or metabolic rate that has to do with the level of activity in the space.

You have one met level if you're seated doing just desk work, another met level if you're seated and doing something active, like typing, and another met level if you're in an aerobic activity or something. But we have a default met level of 1.2 mets, which is seated light desk work that can be used in calculating this set point.

The COA and the CR are the outdoor air concentration of CO2 in parts per million and the room concentration in parts per million. The CR is what the sensor would actually be controlling to, and the outside air would be whatever the ambient level of CO2 would be. And obviously, there is some tracking of those two. If you're trying to provide 15 CFM per person and you have higher levels of CO2 outside, then you will, in fact, have to bring in -- you will be maintaining a higher set point within the space to get the same level of dilution.

Under the default conditions of 400 parts per million outdoor air concentration and 1.2 mets, you will find that 15 CFM per person, inverting that question to solve for CR, you'll find out that that, in fact, is equivalent to 1100 parts per million of CO2. So it's significantly higher than the previous set point of 800 parts per million.

In the paper that's out there on the desk, the part one measure analysis and life cycle cost, appendix B talks about this in more detail, and there are a number of citations that point to other codes, standards and research bodies that have really concluded that 15 CFM per person is adequate for indoor ventilation, and that there is no potential harm or risk to occupants from having CO_2 levels at 1100 parts per million versus 800 parts per million.

This is data from the life cycle cost analysis. We went to three vendors and we got their cost, and I believe these also include the contractor markup of 25 percent, but vendor A, B, and C each gave us the cost of adding a CO_2 sensor and its associated controls as an adjunct to an air site economizer. So the assumption is that the air site economizer is already being bought for the unit.

And you need that air site economizer there, because you actually need to be able to move the outside air damper and have a control that can dynamically change that damper in response to CO_2 signal. And two of the major manufacturers of packaged economizers bundled the CO_2 sensors with the economizer. And then these are the main air handling unit manufacturers or air conditioning manufacturers, reflecting those costs from those two third-party economizer manufacturers.

On the left-hand side we have the incremental costs ranging from $310 to $700 per system, and on the right side we have the manufactured reps' estimates of how long it takes to actually install the sensors in the field. You can see that vendor C was a real outlier in terms of labor, and we concluded that it was probably because that particular manufacturer's rep didn't have much experience with this technology. And took as a reasonably conservative assumption the parts being $375 worth of markup, which just falls right below vendor B, it's kind of an average of the three, if you will, and the labor being two hours, which is slightly larger than either vendor A or vendor B had anticipated.

In the end our cost-efficient threshold is well above this life cycle cost threshold, so we could actually afford to buy a more expensive system than $575 per system.

We did DOE 2 modeling, using the 2.2 engine and E Quest, modeled building with a single interior zone. And we looked at all 16 climate zones, and the results are in the measure analysis and life cycle cost report.

We assumed a flat occupancy schedule for the CO2 kind of demand control ventilation simulation, and I've got several slides following that will describe why we came up with this as being the right way or doing it, but we basically made the results independent of when those people were in the space or out of the space, so that we weren't, if you will, skewing the results by assuming that everybody is leaving during the peak period, or underestimating the results by assuming everybody is just out of the building in the mornings and the evenings. That will vary tremendously by end use and occupancy.

We looked at a single zone package unit with air site economizer. Again, the economizer is assumed to be there to begin with, and justified by the life cycle cost effectiveness of the economizers. This is an adjunct to that requirement, and it is a mandatory measure, I should mention. And then we used the consistent rates, in this case flat rates, for electricity and therms, as were being used by the other measures.

This gets into why we chose a 50-percent schedule and, as I said earlier, it depends, if you imagine, like a movie theater is going to have its peak occupancies perhaps in the mornings and the evenings or in the weekends it could be in the middle of the day, whereas a school may have their peak occupancies in the late mornings and the early afternoons, but they'll be out of the classrooms at lunch. It will be all over the map, where these various occupancies peak.

And so we looked at the schedules that were available from ASHRAE standard 90.1 in the first public review draft of 1999. There were four schedules that we felt were appropriate for this requirement, including the ones used for museum, general exhibition, theater, auditorium, theater lobby, supermarket, library, assembly space, religious, theater performing, and so on and so forth. We also looked at the ACM manual and the defaults in E Quest for secondary schools.

And we took each one of those schedules and we looked at the integration, if you will, how many people hours there were, or another way of looking at it is during the occupied time, from the moment the space is open to the moment it's closed, if you integrate the schedule and you say what is the average of that schedule over the occupied time, those numbers are reported at the end. And almost all of them are right around 50 percent.

The standard 90.1 schedules are 50, 54 percent, 51 percent, 52 percent. The E Quest schedule for schools was at 41 percent, and the ACM manual was right around 70 percent, when you account for differences in how you look at the occupancies. So we used 50 percent as our number.

This is a graphical representation of the same thing. Unfortunately, the laser pointer is out or I'd -- well, barely there. This is the schedule we used, and these are all the other ones that are mentioned in the previous slide and also in the measure report.

Okay. These are the life cycle cost results. All 16 climate zones are shown down here, and they're identified over there. Down at the very bottom it looks like we've got climate zone 15 down here, and at the very top is one with a -- actually, maybe it's climate zone 14. Little easier to see on -- It doesn't matter.

Anyway, you've got all the climate zones here, and then there's a dash one that has the weighted average. And this weighting came from new construction activity in each one of the climate zones, and it's consistent with weighting factors that have been used in the envelope and lighting and other elements of the standard, but this is the weighted average.

And we're showing the threshold to be wherever there is an air site economizer. Well, the requirement for air site economizers is really set at about six and a half tons, but effectively a seven and a half ton unit is the first unit that kicks in, except for a couple of outliers -- there are some six and a half ton units out there.

But if you took a seven and a half ton air conditioning unit, and you laid it on this graph of area per person and zone size, you'd find that it roughly would follow this line here. And there's obviously some assumptions about what the lighting power densities are, coincident with the internal loads from the people.

But you can see that that economizer requirement effectively puts us above the life cycle cost threshold at all of the 16 climate zones, with the exception of the very low occupant densities in these climate zones here that are just slightly above that line. But in aggregate, we're more than conservative on our assumptions here.

I mentioned this earlier, air site economizer costs are not included in the analysis. They're already required under the standard and the prescriptive requirement 144, subsection E. And multiple-zone systems were looked at originally, but we've decided to leave them out of the requirement for a couple of reasons.

First of all, it's almost impossible to do the kind of cascading of controls, from the CO2 sensor to the terminal units back to the outside air damper that would be required to implement demand control ventilation without DDC. And there is no present requirement in mechanical systems requiring DDC control, and therefore, we felt that it was inappropriate at this time to require them, if you will, as bundled as part of the demand control ventilation.

Furthermore, there are really no guidelines on how to cascade the terminal device, resets, and the outdoor air damper controls.

There's lots of information about how to do this on a single-zone system, but multiple-zone systems are complex.

And finally, we're doing some research under an unrelated California Energy Commission public interest research project to really look at how to do this stuff, so that we can at least put some guidelines into the public arena and discuss how these controls should be implemented in multiple-zone systems.

And there we are. So I'll go ahead and save the rest of my time for questions.

WORKSHOP CHAIR ALCORN: Okay.

Ahmed?

CONTRACTOR AHMED: Yeah, A. Y. Ahmed.

Mark, I do not understand what is the base case and what is the DCV case, because if the base case already has an economizer and it's operating under all conditions, and the DCV is operating under supposedly CO2, which you really have not modeled in that DOE 2. You don't have a CO2 sensor in the DOE 2 model.

CONTRACTOR HYDEMAN: Correct.

CONTRACTOR AHMED: And then the ventilation could be coming on at the hottest period of the day, and, in fact, it could actually consume more energy.

CONTRACTOR HYDEMAN: Yeah. Let me address this in two parts. First of all, I apologize. I should have clearly outlined the base case, which is outlined in the report but not covered in the slides. The base case is a system that has an air site economizer. It has 15 CFM per person, the designed peak occupancy, so you take the square foot per person times 15 CFM per person. And so we have a fixed set point, and that's the minimum of the economizer and it's there all the time.

What we did with the demand control ventilation case is we effectively set that set point down 50 percent. We said there are half the people in the space on average during the occupied time, and we compared those two.

CONTRACTOR AHMED: Right.

CONTRACTOR HYDEMAN: Now, there are a couple of things about that assumption. One is when are those people really in the space and not in the space. And if you really begin to look at these different occupancies, you realize that some of them have their peaks early in the mornings and late in the afternoons. Others have them in the middle of the day.

We used levelized rates in this levelized profile of when the savings were to try and smooth out all of those variations. Now, that may not be the right technical answer, but we didn't have any data that would point us to a better one.

CONTRACTOR AHMED: Right. I was thinking of the example where, say, at 2:00 in the afternoon there's lots of people in there, and you have to bring in 100 percent outside air. Actually, it could actually use a lot more energy than the regular economizer.

CONTRACTOR HYDEMAN: No, again, if you think about the regular economizer, if you say you have ten square foot per person and you've got 100 square foot of space, you've got ten people in this building. You've got 15 CFM per person, so I now have 150 CFM is my minimum set point on the base case.

Using current Title 24 without any demand control ventilation, you would set the minimum set point on that economizer to 150 CFM. That's exactly what we did in the model. But with a CO_2 control, what you're saying is that floor gets to vary down to .15 CFM per square foot if it's an other occupancy, or all the way up to 150 CFM. But if you have the maximum load on that space, whether it happens at 2:00 o'clock in the morning or 2:00 o'clock in the afternoon, it's only ten people.

CONTRACTOR AHMED: Right.

CONTRACTOR HYDEMAN: So 150 CFM is the maximum. It will never use more energy than the base case.

CONTRACTOR AHMED: The second part was what happens in buildings that are only heated and not cooled? Will that be a requirement?

CONTRACTOR HYDEMAN: Well, you know, it's interesting, because most of the savings -- if you dig through the analysis, you'll find that most of the savings were on the heating side. It actually -- tremendous savings in the morning and the afternoon. So I would argue if you threw out the cooling energy impact of this and just looked at the heating savings, given how much of a band there was between the life cycle cost, effectiveness and the threshold for economizers, you probably would still be able to show it to be cost effective.

CONTRACTOR AHMED: Okay.

CONTRACTOR ELEY: I have a couple of questions, if I could. Two things. One is just I think to get clarification.

This requirement only applies when an economizer is already required, right?

CONTRACTOR HYDEMAN: Well, the way it's written, it's if you have an air site economizer. Slightly different.

CONTRACTOR ELEY: Okay. So for the majority of classrooms in California, they are served by single-zone systems that are typically smaller than 2500 CFM and smaller -- and they have a cooling capacity lower than 75,000 BTUs an hour, so for most classrooms we would not be requiring demand control ventilation, unless what you're saying, if they happened to put in an economizer for other reasons, then they have to do this also.

CONTRACTOR HYDEMAN: The way it's written presently, that's correct.

CONTRACTOR ELEY: Okay.

CEC STAFF PENNINGTON: I'm a little curious about that point, relating to schools. The schools application was where this was viewed as possible. And so are we talking about auditoriums in schools, or what kind of space?

CONTRACTOR ELEY: A classroom.

CEC STAFF PENNINGTON: And the classrooms and -- So it's going to be some sort of central system that serves a big building? See, I'm not following where this affects a classroom.

CONTRACTOR HYDEMAN: There have to be two conditions to exist for it be required -- Well, let's talk about schools. The auditorium is a --

CONTRACTOR ELEY: Well, just talk about classrooms separate from the auditorium, though, because that will make it more clear.

CONTRACTOR HYDEMAN: Okay. Let me just start with the auditorium. Auditoriums typically have a dedicated system. Sometimes they are a zone off a multiple-zone system. But they're typically a dedicated system, they're typically very high density, and they typically are large enough --

CONTRACTOR ELEY: And they would be larger than 2500.

CONTRACTOR HYDEMAN: Right. So an auditorium almost always would fall under this requirement. In fact, an auditorium would almost always fall under the existing Title 24 requirements.

CONTRACTOR ELEY: Only if it had fixed seating.

CONTRACTOR HYDEMAN: Yeah. No, they'll often fall under the UBC high-density occupancy. So anyway, almost always an auditorium would be covered.

The classrooms tend to be much smaller unit sizes. They tend to fall under the present prescriptive requirement for economizers. The units are so small they're typically single-zone units, so even if they have economizers, they're probably non-integrated, and unless they had an economizer, they presently would not be required to meet the demand control ventilation.

Now, the other thing about classrooms is they're very often served as a zone off of a multiple-zone system.

CEC STAFF PENNINGTON: And they wouldn't be required for that reason.

CONTRACTOR HYDEMAN: Right. So a classroom without an economizer would not be required, a classroom with a multiple-zone system would not be required to have this. But a classroom that had a single-zone system with an economizer, as it is written in this draft, would be required to have demand control ventilation and it would be cost effective, if our numbering and our modeling criteria are correct.

CONTRACTOR ELEY: Okay, I have one more --

CONTRACTOR AHMED: But you might like to --

CONTRACTOR ELEY: I'm sorry.

CONTRACTOR AHMED: You might like to set a 7.5 tons limit or something and above that.

CONTRACTOR ELEY: It's 7500, 75,000 BTUs an hour.

CONTRACTOR AHMED: BTUH, yeah.

CONTRACTOR ELEY: Or 2500 CFM.

The second question is, again, maybe it's not even -- the second question is not even important, because it doesn't sound like this requirement would ever be mandatory for classrooms, as it's currently written.

CONTRACTOR HYDEMAN: No.

CONTRACTOR ELEY: But classrooms, the occupancy pattern in classrooms is sort of like a

Boolean variable. Either there's kids in there or it's not being occupied. And this kind of goes back to your very first bullet that said you can only do this with a CO2 sensor.

It seems like maybe in classrooms, and maybe other occupancies as well, a simple occupant sensor could be -- could function almost as well as a CO2 sensor, in the case like a classroom where either kids are there or not. There may be some time when the teacher is hanging out.

CONTRACTOR HYDEMAN: But Charles --

CONTRACTOR ELEY: That's more of a question.

CONTRACTOR HYDEMAN: -- I would argue that if you think about the installed cost for an occupant sensor, and I'm sure Jim Benya probably has some numbers off the top of his head or you'd know, I mean, at $500 for a point, you're probably comparable in cost for an occupant sensor wired --

CONTRACTOR ELEY: Well, no, occupant sensors are considerably less expensive than $500.

CONTRACTOR HYDEMAN: Wired and installed.

CONTRACTOR ELEY: Oh, yeah.

CONTRACTOR HYDEMAN: Okay.

But anyway, so you do -- right now we're requiring demand control ventilation. It certainly could be that we make exceptions for occupant sensors, but then you have provisions where the demand control ventilation actually are fail safe in ways that may not be with the occupant sensors.

WORKSHOP CHAIR ALCORN: Okay.

Tom?

CALBO REP TRIMBERGER: The question I want to ask, is that for the designer and the building official to figure out, what that low, how low they can go on that setting, or I'm not sure what that's used for, who uses it.

CONTRACTOR HYDEMAN: It's an algorithm that would allow someone to equate the set point of parts per million to the requirement of 15 CFM per person. The challenge here, Tom, is that the right threshold varies depending on the activity level and the outside levels of CO_2.

And so what we tried to do is we tried to provide a default set point, but also provide an equation there that would allow a design professional to design the system under their specific conditions, such that they'd know where to put that set point. And that they could then demonstrate that, using that equation, to the building official.

So something like that equation would end up on the compliance forms, in cases where the set point was being set at other than the default condition of 1100 parts per million. That's one way it could be implemented.

CEC STAFF PENNINGTON: So the building official could check for 1100 parts per million as a criteria, unless the designer specified something else.

CALBO REP TRIMBERGER: Yeah, how do I check -- Where does 1100 parts per million go in?

CONTRACTOR HYDEMAN: It would be -- Oh, you mean how would you --

CALBO REP TRIMBERGER: You've got an R sub P, outdoor air per person is where we're trying to get; is that what we're trying to do?

CONTRACTOR HYDEMAN: Correct, but -- Yeah, in that equation if you look at the C sub R, and you put in 1100 parts per million there, and then under the COA you put in the default value of 400 parts per million, and under the M, which is the met level, you put in the default value of

1.2, the math should come out very close to 15 CFM per person.

CALBO REP TRIMBERGER: And so to get other rates of those, you'd have to go to actually 90 U, whatever.

CONTRACTOR HYDEMAN: No, you would -- They're look-up tables, actually in ASHRAE 90.1 user manual, and we could easily put this in the non-res manual. We would put a table that would give you some default levels for the met, met levels that represent a range of activities.

And with the CO2 sensors, many of them actually have a feature where you can take the sensor and push a button and it will read the background level. It records that background level and uses it in its calculation of what the CO2 is. So some of the sensors actually control the parts per million. You plug in what the met is -- It uses this same equation, but internally, if you will. But other sensors are set by the CO2 level.

CALBO REP TRIMBERGER: So in plan review, is a plan reviewer supposed to look at this and try to determine, you know, is there a lower setting appropriate? Is that what they do?

CONTRACTOR HYDEMAN: What I would recommend is, again, on the form it would say, you know, the facility has or this system has a demand control ventilation system. The set point is, and they'd fill in the blank. If it's 1100 parts per million, since that's the default, that would be acceptable. But if it's not the default, they would show the math and say I used this met level and I used this outside air concentration.

CONTRACTOR ELEY: Mark, is this something that's set in the factory for the unit, or is this something you can adjust it in the field like the temperature on a thermostat?

CONTRACTOR HYDEMAN: The latter, Charles.

CONTRACTOR ELEY: Then what's the -- It seems like this is more a guide for fielding operation than it is something for the building official to worry about.

CONTRACTOR HYDEMAN: I argued that this equation belonged more in the non-res manual than in the standard, but I lost the argument, so I'm in a little bit of an awkward --

CALBO REP TRIMBERGER: So I'm not sure what -- Is this something that, you know, in commissioning somebody we'll check, we'll verify what the setting is on the sensor, and then you just don't worry about what the minimum setting is, or is this where you balance the system to be a minimum CFM?

CEC STAFF PENNINGTON: That's my view of it, that I see this as being something that could be checked in an acceptance testing process.

CONTRACTOR HYDEMAN: It certainly could. And actually, we've talked to Jeff Johnson about adding that to what was presented yesterday.

CALBO REP TRIMBERGER: And so then the demand control ventilation would be kicked in as mandatory and then that would kick in a CO2 sensor with the appropriate setting.

CONTRACTOR ELEY: I have one more question, if I may.

CONTRACTOR HYDEMAN: Mm-hmm.

CONTRACTOR ELEY: If you had a classroom with operable windows and you opened the windows, presumably the concentration of CO2 would go down, and so would the offset air ventilation in a classroom. Is that -- That's what would happen, right? And I guess that's the desired outcome is what I'm getting at.

So this provides a way for the mechanical system to respond in some limited way to operable windows?

CONTRACTOR HYDEMAN: It would, to the extent that you're getting dilution from the operable windows.

CONTRACTOR ELEY: So you mentioned that you were going to develop some guidelines for locating the sensor. Would one of those guidelines be to position it on the back wall away from the windows?

CONTRACTOR HYDEMAN: Well, that's the sort of thing that, because it would be so varied by application, that it would be appropriate for the non-res manual to talk about sensor placement. And there are some existing guidelines out there in the literature, in the manufacturers' literature and in the trade publications. And we could certainly reference that in the manual.

CONTRACTOR AHMED: I have a couple of questions, Mark. At 1100 PPM, the reference is 400, in other words?

CONTRACTOR HYDEMAN: Correct.

CONTRACTOR AHMED: So, therefore, you can have an increase of 700 PPM, or is it that above 1100 it becomes some hazard? In other words, should the CO_2 sensor make a difference, or it should be that if it exceeds a certain amount, then demand control ventilation should kick in? Because outside you could have 1000 PPM, it doesn't mean we can stand 1700 PPM, can we?

CONTRACTOR HYDEMAN: Yeah, there's -- Yes and yes, or I should say no and yes. In all of the work that they've done to monitor background levels of CO_2, except for extreme cases where you're above some particle of combustion, like you're next to a highway, so if you just take generalized background levels, they tend to vary between 350 parts per million and about 650 parts per million. That's everywhere in the world.

So you wouldn't find general background levels up at 1000 parts per million; however, if you were drawing your outdoor air from a building that's just adjacent to a highway, it's possible it could be up at 1000 parts per million, in which case you've probably not done a very good job of locating that unit. So that was one question.

The other question is, is there a threshold that's a real problem.

CONTRACTOR AHMED: Right.

CONTRACTOR HYDEMAN: I refer you to appendix B --

CONTRACTOR AHMED: I read that, that's why I was asking the question.

CONTRACTOR HYDEMAN: -- but the conclusion of the research community, people who are smarter than me and that's usually most of the population, but the consensus is that CO2 in itself is not hazardous until you get up to many thousands of parts per million, tens of thousands. And that's before you can even begin to notice effects on people.

So the 1500 parts per million or 1100 parts per million are not things that you would notice, in terms of people's performance, alertness, other things. Now, remember, it's proxy for ventilation.

CONTRACTOR AHMED: Right.

CONTRACTOR HYDEMAN: And there are other things in buildings we have to worry about, like outgassing in the carpets and others.

SPEAKER PIERCE: Tony Pierce with Southern California Edison. Just a comment about the controls and natural ventilation or operable windows. In demonstration projects, you know, we've had a lot of them where we've done demand control ventilation for classrooms, schools particularly, with operable windows. And there's a lot of discussion about should there be an interlock.

Charles, when you were describing, you know, would there be a dilution effect with the fans still running, I think the answer is clearly yes, but you would also then have cycling of the refrigerant components, which we don't want to have happen from an energy standpoint.

So I'm not necessarily advocating that we have an interlock control because of the cost issue, but it may be something that Mark, when you were referring to creating a guideline, that we put in some type of control interlock to shut down. What we tried to do is just do an educational piece for the faculty, say when you open the windows just like you would do at your home and turn off the HVAC.

CONTRACTOR HYDEMAN: Yeah, there's a -- I was really hedging in my response to Charles, because it depends on whether or not air mixes from that window. The fact is that buildings run under two separate and distinct scenarios. They run under infiltration type of scenario, where there's really no fan pressurization, and they run under a fan pressurization scenario. So if you're bringing in outside air, you're pressuring the space and you open a window, you're not bringing in air from that open window. You're largely exfiltrating through there, and it's become your barometric relief.

And so I'm not sure, in fact, that that CO2 sensor would cause you to reduce the amount of outside air, but it's not going to really increase the load either. It's just -- People really don't know how to run buildings as well as control systems do in some way, and the right way of dealing with that is to put an interlock on a window on an AC unit, whether or not there's a DCV control there.

SPEAKER PIERCE: Yeah, and I probably should have prefaced my remark to the schools that we've worked on is that they were designed for natural ventilation, so they have fenestration on opposite sides or clear story or monitored fenestration, so you do, in fact, get cross-ventilation. So it's not local to just the window, where what you're describing would be the case.

CONTRACTOR HYDEMAN: Yeah, as long as you have wind pressure. But I remember dealing with Larry Palmeter on this issue and there are a lot of infiltration studies showing that when a building is pressurized at all that it almost completely negates the wind and temperature-driven stacked effects.

CONTRACTOR ELEY: I have, Bryan, if I may, one more question.

WORKSHOP CHAIR ALCORN: Sure.

CONTRACTOR ELEY: This is a modeling question. Do you have any recommendations on how, from the ACM manual, on how this would be modeled? Because if economizers are not required and yet you put in an economizer, then you have to put in one of these. So your proposed design would have both the economizer and demand control ventilation, while your standard building would have neither an economizer nor demand control ventilation. And so we do have to deal with model rules in the ACM on how to deal with this.

CONTRACTOR HYDEMAN: What we're recommending is anytime you have demand control ventilation with an economizer that you use 50 percent of the minimum position for that economizer, which is exactly how we modeled it here.

In other words, you take the same kind of levelizing effect, and you say if my minimum position is based on 15 CFM per person at the demand occupancy or the design occupancy, you assume that only 50 percent of those people are in the space at any given time, and you take half of that number as your minimum position on --

CONTRACTOR ELEY: So basically, you reduce your outside air by 50 percent constantly.

CONTRACTOR HYDEMAN: Only when you're on minimum position, which is only where the air is so cold outside that --

CONTRACTOR ELEY: Right, or it's so hot out.

CONTRACTOR HYDEMAN: So hot, right.

CONTRACTOR ELEY: Okay, I got you. Okay.

WORKSHOP CHAIR ALCORN: Are there any more comments on this topic? I saw a hand raised back there behind Ahmed somewhere.

Okay. I think it's time to move on to the -- Mark, do you have a closing comment?

CONTRACTOR HYDEMAN: No, am I on time?

WORKSHOP CHAIR ALCORN: Actually, we're running a bit behind.

CONTRACTOR HYDEMAN: Okay.

WORKSHOP CHAIR ALCORN: But not because of you.

The next topic is Cooling Towers, and Mark Hydeman will also present on that topic.

CONTRACTOR HYDEMAN: Yes. Steve Blanc.

PG&E REP BLANC: I just wanted to introduce the topic by saying this is one of the seven topics that PG&E is presently bringing to the Commission for inclusion in the 2005 update of the Code. There are three basic measures that we're looking at. Further limitation of air-cooled chillers in that area where air-cooled chillers may be substituted for water-cooled towers, including a provision for cooling tower flow turned down to further increase the flexibility of said towers.

And third, a limitation on the use of centrifugal fans for our cooling towers, as opposed to propeller fans, because centrifugal fans are much less efficient. All this work that Mr. Hydeman has so diligently done is also outgrowth of a lot of work that PG&E has done. Mr. Hydeman has been intimately involved in it for many years, so I will turn it over to him and let him talk about it.

CONTRACTOR HYDEMAN: I'd like to introduce myself again, because although I'm the same person I now have changed hats. I'm Mark Hydeman from Taylor Engineering, and this is work that was funded by PG&E through Heschong Mahone Group as part of the case initiatives.

Cooling tower methods, next slide, please. There is, as Steve mentioned earlier, there are three separate requirements and we'll deal with these serially; in other words, I'll deal with each one, one at a time.

The first one is a brand new requirement and it doesn't exist in 90.1, it doesn't exist in Title 24. We're recommending that we limit the application of air-cooled chillers, period so you would have to have a water-cooled plant above a certain size.

The second one is that we make a provision for cooling tower flow turned down. I'll get into what this means --

CONTRACTOR ELEY: These would be

prescriptive, not mandated.

CONTRACTOR HYDEMAN: These are all prescriptive measures, thank you, Charles, for an important clarification.

This is a measure to make sure that you've designed towers such that you can handle variation of flow, so if there are more than one chiller in the plant, more than one cell in the tower, you could run more cells of tower than you have chillers operating at any moment, and I'll talk about why that's important.

And finally, the third one that Steve mentioned is a limitation on the use of centrifugal fans for cooling powers, and I'll elaborate on that as well. So the first issue, please, slide?

This is the air-cooled chiller. I wanted to go through the issues briefly. Air-cooled systems, air-cooled chillers as opposed to a water-cooled plant, with the cooling water and the condenser water pumps are less expensive, but they're also less efficient than water-cooled systems.

And this came to the forefront when we were putting in the first requirements on cooling towers. The cooling tower industry came to us and said, hey, if you don't put a limitation on air-cooled equipment, you make our equipment bigger and more expensive, aren't you in danger of shifting the marketplace to less efficient equipment that also happens to be less expensive, and that would be kind of an unintended use of the standard.

So we decided, under this effort, to take a look at this. And we know from experience a lot of times, we do this on real jobs, that if you do life cycle cost analysis in detail, the water-cooled plants pay for themselves.

So this experience is based on a number of real jobs that we've done out of our engineering firm, including several large office buildings where we've done detailed life cycle cost analysis. We extended the analysis to include three climates representing the range of wet bulb temperatures or the range of humidities within California, and we did that by looking at all of the hourly data that we had and bin data for California, trying to find out where the peak wet bulbs are, and they range between 65 degrees and 73 degrees, and so we selected two climates on the extreme and one in the middle.

And finally, we decided to look at a range of plant sizes from 200 tons to 600 tons, with the idea that the break point is likely to fall someplace in the middle there, as it had on many of the projects that we had looked at individually.

The assumptions for the air-cooled plant are shown up here, the number of chillers in each case -- We looked at two chiller plants, both air-cooled and water-cooled. And we got detailed cost data from a number of manufacturers and put the average cost together. We included things like the screen wall for putting a screen around the air-cooled chiller. We included the water costs in the costs of maintaining that water-cooled system with bioside and other chemicals.

And the incremental costs of the water-cooled system versus the air-cooled system are shown here. The only reason they're climate-dependent is that when you fix the tower approach for design at seven degrees, that tower gets bigger when your wet bulb goes down. So you'll notice a milder climate. It's actually a little bit bigger tower and, therefore, more expensive than in the more aggressive climates.

On the assumptions for the water-cooled, in each case, again, we were -- two chiller plant, the first two were screw chillers, the 200 and 400-ton plant. Screws tend to be very cost-competitive. We know this from hundreds of performance-based bids that we've done on chilled-water plants, but they tend to be cost-competitive 300 tons and below.

And above 300 tons we went to a centrifugal chiller. That, by the way, is consistent with the ACM recommendations that default chillers are screws below 300 tons and centrifugals above.

We used the default curves for water-cooled screws, centrifugal, actually the ones that are out of the ACM manual. We did size a tower for a seven-degree approach, and use an 18-degree Delta T on the condenser water system based on a lot of optimizations that we've done.

On the air-cooled side, we looked at all screw chillers, because they tend to be screws throughout the full range. There are air-cooled centrifugal chillers. They're kind of a niche market sold in Saudi Arabia and places like that, but not in any amount in the United States. And we used the basic Title 24 efficiencies in both cases.

These are the results for the three climates. I'm going to walk you through each of the climates individually. The first one is San Francisco. It's the mildest in terms of a wet bulb temperature, and this is the actual life cycle cost threshold for the three cases, 200, 400 and 600 tons, using two different rates.

We looked at the blended rate or the present value rate, which is kind of a flat rate, and we also looked at the CEC time-of-use rate. There were three different rates that were presented to us: the flat rate, the time-of-use rate, and then there's the one that's intimately variable, based on almost kind of a -- I'm losing the --

UNIDENTIFIED SPEAKER: TDV.

CONTRACTOR HYDEMAN: TDV, yes, the TDV rate. But we looked at that and the first two, and you'll find that, in fact, on both of these rates it really bottomed out at about 200 tons.

The net present value of an air-cooled versus a water-cooled become equal right around

200 tons and at that zero mark, if you will. So this is the results for San Francisco. As we go to a 70 degree wet bulb, which is Long Beach, it was right around 200 tons again for both grades. And then finally, if we look at Fresno, it could be justified below 200 tons.

This is a new requirement, so we decided to be a little bit conservative with it. Because we realized that it's going to take industry and common practice a while to get used to this, so we actually dropped the -- or moved the capacity up from the threshold of 200 tons up to 300 tons, so a 50-percent increase on this.

And we're suggesting a new prescriptive requirement, as Charles pointed out, that would read, "Chilled water plants shall employed water-cooled chillers." The exceptions are air-cooled chillers may be installed up to a maximum total installed capacity of 300 tons, and the second exception right now is one that I'm sure Tom is going to take exception to, and that is where can we demonstrate to the authority having jurisdiction that water quality prohibits the use of water-cooled equipment.

We are working presently with some of

the manufacturers of water treatment to see if we can't come up with a benchmark; in other words, is there a benchmark of dissolved solids or biological contaminants that we could use and put in prescriptively here, where you could just check a water quality report and say it either meets this threshold or not.

We haven't been able to get any consensus on those numbers yet, so we're leaving it open for the time being, but I would be very interested in getting some data if anyone has it, so that we could make it more prescriptive based on the actual measurements of the water quality.

This is the second measure. It talks about cooling tower flow turndown, and there are two ways of doing it. Standard practice has always been that when you have multiple cooling towers -- This shows two cells of cooling towers, two chillers and two pumps -- you put isolation valves there.

Now, typically you'll have an isolation valve that's a manual valve that you'll use to isolate this tower so that you can scrub the basin out and clean it. That's fine. But the real cost is in putting an automatic actuator on that valve, such that when you shut one pump down and one chiller down, you can also shut and isolate one tower.

It turns out that adding that actuator is more expensive than designing the nozzles on the tower such that you get excellent coverage of the fill on the tower to protect the tower itself over a range of flows. And most of the manufacturers and almost every configuration of tower can provide a three-to-one turndown for less money on the tower than you would pay for the actuator on that valve. But you have to do one or the other to protect the tower, and we're recommending that you do number two, because it's cheaper and it saves energy.

Turndown saves energy and it reduces first cost. The tower can more efficiently reject heat with more cells operating because you get near cube law savings in the fans, and a three-to-one turndown ratio on towers costs less than about $500 a cell. By the way, this is an excellent retrofit on towers, we find.

And the isolation control actuator, wired into the control system, costs typically $2,000 per cell. So that's our life cycle cost analysis. It's cheaper and it saves energy.

The cooling tower proposed prescriptive requirement for flow turndown reads, "Heat rejection units configured with multiple water condenser pumps" -- I mean, if you only have one pump, obviously you're not going to get any flow variation. So if you have multiple pumps -- "shall be designed so that all cells can be run in parallel with the larger of the flow that's produced by the smallest pump, or 33 percent of the design flow."

Again, three-to-one is generally where most of these tower manufacturers can get to, depending on how the tower is configured and what the design conditions are on it.

CONTRACTOR ELEY: Mark, a question about that?

CONTRACTOR HYDEMAN: Yes.

CONTRACTOR ELEY: You're triggering this to multiple pumps, but you, I guess conceivably you could have a variable speed pump, single-variable speed pump on the condenser water line, right?

CONTRACTOR HYDEMAN: True. So it would make sense if you -- I've never seen a plant configured that way --

CONTRACTOR ELEY: Neither have I, but you could do it, right?

CONTRACTOR HYDEMAN: You could do it. You lose the redundancy. You pay more for the installed -- No, maybe not.

Anyway, it's something to consider.

CONTRACTOR ELEY: If you modify the language slightly, it could account for that situation.

CONTRACTOR HYDEMAN: Okay. The third one, as we were talking about, limiting centrifugal fans. My favorite image of this is going to UCSC when I was doing work there in the earth and marine sciences lab, and there's a whole bunch of towers sitting out in the woods. They're far away from buildings, it's not a noise concern. There's no height restrictions, because the trees tower over the towers, but they're on pads, side by side, these big draw-through propeller fan towers, side by side with blow-through centrifugal fan towers.

The only difference is that the centrifugal fan tower is using twice the energy of the propeller fan towers for the same heat rejection. And people have them there because that's what their standard spec is.

Now, why do people use centrifugal towers? Well, low profile applications, certainly, there is nothing that will get lower than a centrifugal fan tower, when you pull the fan out and the tower squishes down. That super-low profile only occurs in the smaller towers, so we're going to have a size requirement that gets around most of this. But generally, you can work with the architects early on in siting the towers, such that you can accommodate height restrictions, but it is an issue.

The second one are applications with high static pressure, like towers that are sited in a well, where you have to discharge some distance through ductwork or you have to bring the inlet through ductwork, or where you can't meet the sound power levels, acoustical requirement and you have to put in sound traps inlet and/or discharge. Typically you'll have high static, and those are legitimate uses of centrifugal fans.

The third one is the noise-sensitive applications; at least, that's what most people say about them. But the fact of the matter is that propeller fan towers are designed now in such a way that you can actually get lower sound power levels out of a propeller tower as you can from a centrifugal fan tower, or where the centrifugal fan tower doesn't have external sound traps. So this one becomes far less important, and I'll give you some data on that in a moment.

Centrifugal fan towers use twice the energy of propeller fan towers, and you can see that, that's reflected in the tables in section 112, there are separate requirements for centrifugal fan towers and propeller towers, and I think they're on the order of 80 GPM for horsepower for propeller power, and something like 40 GPM for horsepower for -- That sounds wrong. It's probably 40 and 20, although you can get propeller fan towers as efficient as 80 GPM for horsepower.

The second one is in large tower sizes, less than -- sorry, greater than 300 tons, it should be greater instead of less than. Without sound attenuation on the centrifugal tower, propeller towers with attenuation cost less, and are quieter. I've got a quote here from our local BAC rep, and he did a run between his centrifugal fan towers and his propeller towers, and for the same heat rejection, a centrifugal fan tower for a 500-ton tower costs $26,000, with its what they call the low-sound package on it. And the same thing for -- Sorry, that's a propeller, $26,000.

For a centrifugal, out the door with no sound attenuation costs $27.5 thousand, and the propeller fan tower is actually quieter by about four to six decibels. So you can get a quiet propeller fan tower by slowing the blades down, by putting more mass in the blades, and by adding these very low pressure inlet and outlet sound traps. Costs less, uses less energy. It's another one of those things that's immediately cost effective.

Larger towers, propeller towers are also available in a reduced height configuration, where they make them superwide and low from a number of manufacturers. So, having said all that, next slide, please, we come to the proposed requirement, new prescriptive requirement.

Heat rejection units serving cooling loads greater than 300 tons, so again we put a size requirement on this, recognizing that some of those very low height towers are available in the smaller sizes and greater should use propeller fans in lieu of centrifugal blowers.

Well, there are a number of exceptions. If heat rejection units are located indoor and require external static pressure capability, if the acoustical engineer certifies that acceptable noise levels cannot be achieved with propeller fan tower, and typically then you'll have to add some external sound attenuation on the centrifugal tower as well and you'll need the extra pressure, and if the heat rejection unit meets or exceeds the energy efficiency requirements for propeller fan towers. So if someone can make a superefficient centrifugal, that's fine. It's essentially the same thing.

CEC STAFF PENNINGTON: One comment I would have --

CONTRACTOR HYDEMAN: Yes?

CEC STAFF PENNINGTON: -- is, as you know, I'm not too keen on that second exception, and maybe a performance standard approach to get around that is preferable.

CONTRACTOR ELEY: Well, for one thing --

CONTRACTOR HYDEMAN: We're certainly

open to doing that.

CONTRACTOR ELEY: -- the acoustics is, there is no licensed acoustics engineer. They're -- Mechanical engineers are generally your acoustics engineers, so we would have to be specific about that.

I have a couple of questions.

CONTRACTOR HYDEMAN: You've got the mic, Charles.

CONTRACTOR ELEY: You're not proposing any limits on closed towers versus open towers, it's just the fans; is that right?

CONTRACTOR HYDEMAN: Correct. This would not impact what are known as closed circuit fluid coolers, which serve things like water source heat pump systems and auxiliary condenser loads.

CONTRACTOR ELEY: Okay. If you have a system with towers but no chillers, would these requirements apply?

CONTRACTOR HYDEMAN: You're thinking about somebody who was using towers for, like, indirect evaporative cooling or something like that?

CONTRACTOR ELEY: Right.

CONTRACTOR HYDEMAN: There's no reason they shouldn't.

CONTRACTOR ELEY: Okay.

CONTRACTOR HYDEMAN: The issues are the same.

CONTRACTOR ELEY: Okay.

WORKSHOP CHAIR ALCORN: Yes, Steve?

SPEAKER GATES: Steve Gates with Hirsch and Associates.

Mark, as part of the turndown discussion, I didn't notice that -- any comment about turndown on the fans. Is that already required in the standards, or -- Okay, so that's why it's not being specifically addressed as part of this. There are already like two-speed fans or variable speed or something like that to --

CONTRACTOR HYDEMAN: Right, we set it for two-speed fans, and it can be a one-third, two-third, or a 50/50 --

SPEAKER GATES: Right.

CONTRACTOR HYDEMAN: -- and variable speed drives also meet the requirement.

SPEAKER GATES: Okay. The other comment, Charles had raised the question about a variable speed condenser pump, and would that be acceptable in terms of in comparison to, you know, one pump per chiller? And actually, that would not be a good application for a variable speed in this case, because ideally for variable speed, you want to be able to have the head drop off -- In order to get the cube savings that everyone likes to talk about, the head has to drop off as a square of the flow.

But if you've got one pump that's serving two chillers and one chiller is running, it still has the same head requirement as before, since the chillers are in parallel. And then on top of that, you have the static head of the tower itself, just the fact that you have to lift the water up to the top of the tower and then let gravity flow through it.

So the head drops off as the square of the pump speed, so what you would find in that application is that if you went with a variable speed pump, chances are it's going to be running at about 85 percent speed minimum, even with only one chiller running. So in that particular situation, you're much better with one pump per chiller.

Now, that pump for that chiller might

be variable speed, because then you can take advantage of some of these issues, but in terms of having a single pump multiple chiller variable speed, it's not a good match for a variable-speed drive.

CONTRACTOR ELEY: Are you recommending we put in a prohibition against variable speed pumps?

SPEAKER GATES: You might want to look at it. You know --

CONTRACTOR ELEY: That would be a neat twist.

SPEAKER GATES: -- I saw, when I did temperature controls I was involved with a large thermal energy storage system at a university that shall remain nameless, but it had several distribution pumps with 150-horsepower variable speed drives on them. And as the controls engineer I was looking at it, and when I actually did the head analysis on it, what I told them was you're better off with stage pumps, because this variable speed drive is always going to be running at least 92 percent speed.

And no one believed me until after the fact when they then called back and said how come these pumps never slow down. And it's like, well, it's because your head isn't dropping off with the square of the flow. So it's something that has to be looked at on a case-by-case basis.

The cube laws for towers actually apply quite well with variable speed drives, but for most -- you know, as most engineers know, for HVAC applications, it doesn't necessarily follow. It really depends a lot on what's happening in the system.

WORKSHOP CHAIR ALCORN: Ahmed?

CONTRACTOR AHMED: Mark, on the chiller, air-cooled versus the water-cooled chiller, your recommendation is that air-cooled chillers may be installed up to a maximum of total installed capacity of 300 tons; is that total systems tonnage, or is it multiple systems or one system, total tonnage should not exceed 300 tons? In other words, can you have three 100-ton air-cooled chillers?

CONTRACTOR HYDEMAN: As it's written now, yes. And as it's written now, you could even have up to 300 tons in a combined plant, unless we change the words on this.

CEC STAFF PENNINGTON: This is actually

an area that staff had had some difficulty in understanding what was the intent, you know, what capacity are we talking about, whether it's the chiller or the whole system.

CONTRACTOR HYDEMAN: The intent is that it's the total installed plant capacity, and we might consider changing the words such that they can be installed on plants that are 300 tons and less, and just leave them out. We're likely to get some pushback from industry on this one.

CONTRACTOR AHMED: Yeah, the concern was that I know some coastal communities do not like water-cooled chillers because of the ocean, you know, proximity to the ocean. They damage and they require too much maintenance.

CONTRACTOR HYDEMAN: I would imagine you'd have the same problem with the air-cooled condensers, though. I mean, you've got --

CONTRACTOR AHMED: The community college that I'm working with, they specifically told me not to design water-cooled chillers. Because they are a very, very high-maintenance item. And they have air-cooled condenser units all over.

WORKSHOP CHAIR ALCORN: Tom?

CALBO REP TRIMBERGER: I have kind of a background maybe question, and I think this applies to the demand control ventilation we talked about earlier. I'm just trying to get a feel for how these regulations go in.

The proposed new prescriptive requirement would mean that it is a prescriptive -- that's the same prescriptive requirement, the same language we've used in the past where it means -- that would become the basis for computer modeling as a prescriptive, but if somebody does an approved calculation method that that would not apply; is that what we're talking about?

CEC STAFF PENNINGTON: Could be traded away for something more efficient.

CONTRACTOR HYDEMAN: Right.

CALBO REP TRIMBERGER: Okay.

CONTRACTOR HYDEMAN: The demand control ventilation, all of those were mandatory, just to make sure it's real clear, so they're under section 121, which are mandatory requirements.

CALBO REP TRIMBERGER: Okay.

WORKSHOP CHAIR ALCORN: Are there any more questions on this topic? Mark? Cool.

Okay. Thank you, Mark.

We'll start up discussion or the last presentation. It's on Lighting Power Allowances -- Complete Building and Area Category Methods, and Jim Benya will present this topic.

CONTRACTOR BENYA: Good afternoon. My name is Jim Benya with Benya Lighting Design, and I've been working as a subcontractor with Eley Associates and working very closely with particularly Mazi and Gary Flamm from the Energy Commission on these particular issues, as well as Larry Ayers and Charles Eley.

This particular set of recommendations has specifically to do with the lighting power allowances for the complete building method and the area category method. I just want to recognize that there is a considerable amount of interaction between this particular contractor team and Commission staff, and what we do is beat these things back and forth quite a bit before we do them, so there's I think a pretty strong consensus that these values are really what make a tremendous amount of sense in today's market.

The first task in this group was to revise the lighting power allowances for the complete building method. Table 1-M of section 146 contains the allowed lighting power density values for complete buildings, and our task was first of all, to see if there were any space types that could be added. This occurs in both of the major tasks here, because ASHRAE IES 90.1, 1999 has a different list of space types, and so we very carefully examined these to see if there were any that were applicable, and, if so, could be brought into Title 24, so that the two standards have great similarity in that regard.

The second subtask here is to update the allowed lighting power density for all listed space types, and that in turn revised table 1-M. The second major task group involved the area category method and specific allowances for that. Table 1-N of section 146 contains the allowed lighting power density values for area categories. Similar to the whole building method, we looked to see if there are any space types that could be added, we updated the allowed lighting power densities and we revised the table accordingly.

How did we determine the space types to add? The primary process involved looking at other energy codes, specifically ASHRAE IES 90.1

'99, we also took a quick look at Oregon and Washington and Seattle energy codes to see if there were any things that we wanted to bring over.

We then determined whether or not the space has a usable new space type that is covered by the legal scope of Title 24, so there is a slight difference in the legal requirements for Title 24 versus some of the other codes, so we wanted to make sure we didn't step into that one. And then we discussed the space types with staff and chose the ones that made sense was based on a consensus of the team.

With regard to space types, we added under Table 1-M the whole building method, a hotel. Of all the categories that we had in 90.1 and other standards have, that was the one that sort of stood out as an opportunity to add a whole building method. From a compliance design documentation standpoint, adding whole buildings makes the compliance documentation most easy for a designer. It's the least amount of work; however, it is probably the one that is the most restrictive. However, we felt that a hotel was a very good candidate for this.

Table 1-N, what we got ourselves into here were civic facilities, primarily, things that are associated with government, so we had the civic facilities, which would be like a courthouse or city hall, holding cells or jails -- not penitentiaries, they're not covered by Title 24 -- police or fire stations, post offices.

And then two other major categories stuck out. One was housing. The public areas of housing facilities are covered by the non-residential standards. Residential standards only apply to the actual living quarters, and we felt these were a real good opportunity, particularly with respect to ones that we have here, multi-family and the dormitory and senior housing environments.

We also identified transportation facilities: airports, bus stations, train stations, etc., as another opportune area where we didn't have, again, a specific or single set of Title 24 requirements existing that would apply, and we felt that this was a good opportunity to bring forth these unusual space types.

We ended up having to add definitions as a result. I'm just going to breeze through these very quickly. Civic facilities: Here we had to identify the types of rooms that would be included in civic facilities, because when it's being used in the area category method, common spaces such as toilets and corridors and so on are not included, and we wanted to be very distinct about what these actually happen to mean.

Housing in common areas: This one got to be particularly interesting, because over the course of the last few years, the IESNA released one document in particular, RP 28, which provided for lighting recommendations for senior facilities that require much higher light levels than you ordinarily encounter in other types of housing facilities. So we were able to separate this into some significant subgroups.

The first subgroup is multi-family housing, which includes most of the common areas in ordinary multi-family. And you can see we've indicated certain types of hallways, lobbies, common areas and things like that, and we excluded the areas for which there are applicable area categories already existing.

In multi-family housing specifically designed for seniors, here is where we really got into the growing trend towards retirement facilities that identify and cause us to have these concerns about high lighting levels. I personally was involved in designing a retirement facility for faculty and other employees of University of California, Davis a couple of years ago, and this was used, at least by me, as a guide to some of the issues that came across.

One of the things that in talking over that particular problem with Mazi in particular, he and I realized that it was very important to identify what is the difference between senior housing and regular housing. And we have proposed a number of specific qualifying factors here.

They would have to include three or more of the following facilities within the entire permitted project: skilled nursing, assisted living, Alzheimer's care, hospice, and common dining. The reason for three or more is, from my experience designing these types of facilities, you generally have at least three of these. And this is a rather significant way of defining the difference between one of these and an ordinary multiple-family or housing type of unit.

Dormitories such as universities and so

on, these are very, very tricky facilities, because there is a high -- an unusually high lighting level requirement we feel, because of the number of educationally related spaces, and the relatively high room cavity ratios in these facilities. That means a lot of rooms are small with highly absorbent geometries, and so you end up putting in more power than you think you might need.

And our studies indicated that, with the exception of some facilities for which, again, area categories were already defined, particularly multipurpose, reading, rooms like this end up having similar power requirements to areas that are like them in the aging facilities as well, for different reasons, of course.

And so we felt the two were a pretty good match power-density-wise, and so they're included in the same power density group. They're different from standard multi-family housing.

Some of the other definitions we had to add, prisoner holding cell or jail is necessary so that we've specifically identified the scope of these rooms, giving designers and documenters a clear definition of what they're supposed to be focused on.

Police and fire stations: Again, you're going to see this issue now repeated several times. We tried to identify what is and what isn't included to give people guidance as to how to use this correctly. Post office.

Transportation facilities also challenge us. We realize that there are a number of common spaces that frequently occur, and one of the things that is particularly common to these is the notion that there are freestanding specific-use-type occupancies, and I focus on retail, because it is growingly common for a retail establishment to be built in a freestanding nature in a very tall space. You'll find this at most airports, and you'll also find it in other types of transportation facilities.

And so I felt it was important to say what is included, what isn't included, and we're specifically saying what's included are transportation-type facilities, what's not included are the common facilities such as locker rooms and libraries and so on. And specifically, if there is a retail or a freestanding environment, although it's not demised, it doesn't necessarily have a ceiling-high wall, it can be addressed with a different portion of the standard that's appropriate to it.

The next thing we had to do was come up with a process. Well, the process is actually very well established. The process that we used has been used by us before, by other consultants before, by Commission staff before to develop and/or revise standards. It first of all involves saying what's changed since the last time we did this, and we went back to 1995-1998 to try and say, well, what would have been used then and what's going to be used now.

For each of those that we identified we then performed a cost-effectiveness test that is now required using a TDV system that's been presented here before. We determined facilities to which they would be applicable, because not all technology improvements are applicable to all facility types. And then we ran the lumen model and confirmed whether or not a change in the lighting power density for a particular space type or building type might occur.

We identified four significant changes in lighting technology since 1995 or 1998. They are the second generation super T8 fluorescent lamp system, innovative new lumenaire lighting systems using T5HO lamp, the metal halide pulse-start lamp, and the ceramic metal halide lamp.

The T8 second generation super lamp consists of, first of all, premium construction of a cathode assembly designed for extended lamp life. These lamps do cost a little bit more, they're made a little bit more, they last significantly longer.

Use of barrier coke phosphor, which returns unused ultraviolet radiation back into the lamp and reduces lamp lumen depreciation. The improvement is pretty profound. There has been a nominal, roughly five-percent improvement, that's absolute improvement in lamp lumen appreciation, taking the T8 family for around 90 percent up to about 95 percent mean lumens. So it's really extraordinary. That can be taken into consideration and design, and can result in five percent less power.

The use of optimized high sierride (phonetic), which are actually even higher sierride than the standard lamps that are available, and in one case one manufacturer makes a low power lamp, a 30 watt lamp versus 32 for most other manufacturers. And the table at the bottom, which is a little bit hard to read, I'll just cut to the chase, we found that from all three major manufacturers that we could count on a 15 to 20 percent reduction in lighting power use by going from ordinary T8 technology to this new advanced T8 technology.

It's a very significant improvement. I have designed projects using this technology, I have complete confidence in it. There's nothing special about it, it's just a significant step improvement in something we've already come to know and use pretty widely.

The next thing has been a subtle but rather profound change in the -- using the T5HO lamp. T5 lighting systems are not as efficacious as T8 lighting systems using this new second generation stuff. The standard T5 is very close. The T5HO is not nearly as good, but the T5HO, being a fluorescent lamp, can be turned on and off quickly, virtually instantaneously, and it can be used in a surprisingly effective reflector system to do a number of things better than can be done with other light sources.

In particular, we've done a number of projects recently where, instead of going with an ordinary 400-watt metal halide lamp, we've been able to cut the power considerably by going to T5HO lamps in a new generation of T5HO high bay and medium bay lumenaires. You can already do this in medium bay space using T8. The trick here is to be able to do it with T5s in a higher bay space.

We've designed spaces as tall as 40 feet, gymnasiums and big box stores and things like that, using this technology; ice rinks and a variety of project types. And so by going from a theoretical 1.1 watt per square foot to 0.79 watts per square foot, we feel that this does give a significant improvement.

Interestingly enough, improvements in metal halide pulse-start lamps also give us some of that, which we'll talk about in a second, so we felt very confident that anywhere high bay lighting was occurring, we had one or more technologies that could do that. This particular one happens to emphasize the T5HO and what it can do for us.

Then there is the metal halide pulse-start lamp. Traditional metal halide lamps are based off of the fundamental engineering of the mercury vapor lamp, which utilizes a probe starting mechanism inside the lamp to cause the arc to ignite and the lamp to operate. While the probe starting system is relatively inefficient and because this device is in the lamp itself, it causes relatively rapid lumen depreciation and reduces the available lumen package by going to a pulse start, which is a technology similar to high pressure sodium where the starting mechanism is a pulse-generating device outside of the core and coil and outside of the lamp.

You can get a significant increase of lumens, both initial and maintained. A 175-watt lamp, for example, probe-start is 13,600 additional lumens, pulse-start is 17,000. In mean lumens, you've got 8,800 mean lumens with the 175-watt lamp, 12,500 with the pulse-start lamp.

So that's a significant improvement. And what it shows is pretty consistently between 70 and 80 percent of the power of the probe-start needed by pulse-start lamps in the common metal halide lamp sizes of 175 to 400. So again, we felt confident that that approximate 20-percent power reduction could be built into the standard and take advantage of this technology.

Lastly, since the mid-'90s, a type of metal halide lamp called ceramic metal halide has been developed, and it has color and performance characteristics similar to halogen infrared reflecting lamps, and they are available in low wattage lamps that are suited for retail and general use. The comparison I use to demonstrate this is a 100-watt par IR lamp, which is a very, very common retail display lamp in the flood distribution, it's a 3,000-hour lamp that has 6,300 center beam candlepower initially; it has 2,220 lumens initially.

They drop off very little, that's one characteristic that's good of halogen, but for 100 watts, it's 21 mean lumens per watt, and, more importantly, about 60 -- I think it's mean beam candlepower per watt. Yeah, it's mean beam candlepower. When we go to the 35 watt, par 30 flood, this happens to be a Phillips lamp, it is the ceramic metal halide and you can see it's got 10,000 hours of light, 7,400 center beam candlepower initially, 2,000 lumens initially, so it's a little bit more focused beam of light.

It has almost identical mean beam candlepower, and it has a little bit lower lumen output that's tolerable, but it operates at slightly under 50 percent of the wattage, with 36 mean lumens per watt and 132 mean beam candlepower per watt. In other words, you can cut your power about in half. It's about a two-to-one relationship between ceramic metal halide and the most efficient of the tungsten sources we have available today.

This one is pretty tricky, because the two-to-one ratio is not quite as dramatic as we see in other sources, and as is pointed out in depth in the report, this lamp ballast combination is a significant cost increase over the halogen lighting system. And that one was a real challenge.

CONTRACTOR ELEY: But it was still shown to be cost effective.

CONTRACTOR BENYA: Oh, it shows great cost effectiveness, because the lamp life is longer, because it's half the energy use. It pays for itself rather handsomely. The biggest problem that I felt this runs into is in retail construction, you know, we do a lot of retail design and Bernie does too, and he would be a good person to comment on it if he were here, but the first cost of this system is enough to give the developer a little bit of heartburn.

See, the biggest problem is a lot of stores are built somewhat speculatively. And if the store doesn't fly, then you're going to rip it all out in two or three years and you're going to put something else in. So it's not a guaranteed persisting installation. That's one of the things that I always worry about is some of these things you know once they're put in they're going to stay there. You put a two-by-four trougher in a two-by-four lay-in ceiling, it's probably going to stay there for a long time.

Once you start getting into some of these fancy track and retail display lighting systems, a lot of stores gut and remodel. And that's one of the things we have to take into account. So this one is great stuff, I like it but I want to -- I also want to make sure we flag that in the report. We're proceeding with it anyway in a very careful way, because I believe that it's a very, very important technology that we can take advantage of.

We then took it through the life cycle tests and all of these measures passed with flying colors, even the one I'm most concerned about, the ceramic lamp. Most of these, in fact, were so good, it was like why are we bothering to run the test? You know, you could almost inspection and say, gee, the thing pays for itself in the first month. So most of them are really just excellent. As a matter of fact, I'm not sure you even pay a premium for a pulse-start metal halide lamp anymore.

Like I said, the second generation T8 and pulse-start are profoundly cost-beneficial. Very, very small incremental cost; rapid, rapid return on investment. I mean, we've even talked about making pulse-start mandatory, as a mandatory measure it is so much better, and I can't find a down side yet to the pulse-start technology.

The T5HO and ceramic metal halide are good, good enough to use the standard setting data. I don't think they're good enough yet to make them mandatory.

Then we went into the lumen method modeling. This is the same method we have used before for Title 24 standards. It's the same method that's been used by ASHRAE IES 90.1. It involves the familiar lumen method, which is the standard illuminating engineering methodology for determining the amount of lighting.

Basically, you take the number of lumens that are emitted into the space, you correct them by a coefficient of utilization, which takes into account the way they were distributed and the quality of the space, reflectivity and geometry and so on, times light loss factors, which include ballast factors, lumenaire depreciation, lamp lumen depreciation and other things. You divide it by the area of the space.

We had fortunately, with the '98 standards review, Mazi had put together a very, very good set of standard models, and we utilized these models. Each model was reviewed, so we didn't necessarily say we're just going to do exactly the same thing. We checked everyone, we revised all the tables that are used in the calculation, and so it is virtually every calculation has been completely redone, even though such a good job was done previously.

What you do in doing this work, is the

first thing is you identify the footcandle levels for task, ambient, and other lighting requirements. So in a room like this, for example, I might say 40 percent of the room is a task lighting level requirement of 50 footcandles, 40 percent of the room or 50 percent is ambient, in which I would take somewhere between a third and a half of that, I'd probably set it 20 footcandles, which would be consistent with IES recommendations. And then I'd say another ten percent of it is circulation, and I might even set that at ten or fifteen footcandles.

You calculate -- The spreadsheet we use actually determines the weighted average footcandles from that. You then take the number of light sources that are suitable for the application. As is the case sitting here in this room, you can see we have cove lighting, we have track lighting, and we have recessed lighting, and we take those three different systems, and then we take the light source that is suitable for each one of those systems, taking into account dimming and other requirements.

We then determine a representative space geometry. In other words, this room we would say for a conference room or meeting room, a room might be 30 by 30 or 40 by 40 such as the size of this room. We wouldn't make it too small or too large because of the room cavity ratio, which is a function of the room geometry, affects the coefficient of utilization. In other words, the smaller the room gets, the less efficient of a space it is to utilize the light, and we want to make sure these models are pretty representative of the space types we're actually going to have.

And then we determined, using manufacturers' catalogs, a coefficient of utilization and a light loss factor for each lumenaire that's appropriate for that space type. This is where judgment comes in, my judgment in particular, and so I look at a particular situation. I go to a manufacturer's catalog and I say, okay, this conference room, I've got cove lighting, it has a coefficient of utilization in this space of about 43 percent, and I utilize that particular value in doing the calculation. That one is entered manually.

The calculations determine a weighted average illumination level, based on the percentage of space; a weighted average lumen and power contribution from each lumenaire; and the final result is a theoretical minimum lighting power needed to light the representative space. Here we make an adjustment.

By theoretical minimum, of course, we don't take into account the fact that most fluorescent lumenaires are four feet long and sometimes you only have a three-foot ceiling. And so we -- you can't always fit the perfect number of lamps. You can't have 3.3 lamps in a fixture.

So taking that into account, we generally round up to the next highest tenth of a watt per square foot, and usually at least five percent. So in one calculation, for example, the answer was 1.59. We didn't round up to 1.6, we rounded up to 1.7 to address those real-world conditions.

Here is a sample spreadsheet. Copies of all of the spreadsheets are available on the handout table outside. I just wanted you to see what we go through. There is the space type. We put in the description of the space, we put in the dimensions of the space. There is some information here about what we did, what's the current standard and where this one comes out. We add in finishes, a description of the finishes that are used, the reflectance, the light loss factor, and then the footcandle calculations here. In this case you can see we had an average lighting level of only 30 footcandles for the entire space in this calculation.

Here is where we choose the lighting systems and we describe what lamp is used in the lighting system, and in what type of lumenaire. These are from pull-down tables. You can see the fixture types over here and the lamp types are up here.

Next, the program gives us the RCR, and this is where I find a representative lumenaire and the coefficient of utilization from one of the number of lighting catalogs. I try and use products that are representative of good-quality products in the marketplace today, without being too specific. I don't want to nail this down and say this was just a Lithonia or just a Cooper portfolio down light, but I do use Cooper and Lithonia pretty commonly, because they're the two largest manufacturers in the US.

Then the program grinds these numbers out, and comes back and tells us the theoretical watts needed to meet that lighting level, the theoretical power density, and then the recommended values where we eyeball this one and write this one.

And then I add right there with the chandelier allowance, if in my judgment I believe that that space needs to have the ability to have decorative or ornamental lighting, which is usually, and I hate to say it, but it's usually incandescent and often a, just a gimme. We have made that allowance on some space types and I note it right there. So that's how this spreadsheet lays out and you can inspect these at your will.

Bottom line: Here are the changes we recommend. Table 1-M, these are whole building values. I'm only showing you the ones that changed. High bay industrial has gone from 1.2 to 1.1, because of both the T5HO and the pulse-start metal halide. Hotels are new. We tested this value and that value is identical to the value used by ASHRAE IES 90.1 as well. One of the comments we received from NEMA is that they'd like to see our standards, and 90.1 as close to together as possible. In this case it made sense for both the project type and the value to be the same.

Medical buildings and clinics went down from 1.2 to 1.0. The primary reason is because they make heavy, heavy use of the T8 system in these facilities, and they can realize the full benefit of T8 technology there.

Office buildings, 1.2 to 1.1. Again, going down primarily because of the T8 system, but not quite as much because the T5 systems, which are also being used in office buildings, didn't enjoy that significant step. And so we had to be a little careful with that one.

Religious facilities have gone down from 1.8 to 1.6. The primary reason is many of them can and do utilize HID lighting, particularly ceramic metal halide will be a very significant light source in designing the church portion of a religious facility. And given that religious facilities sometimes combine other types of occupancies, we felt that this was a very legitimate reduction.

Convention centers can both take advantage of the T8 and the ceramic metal halide improvements, again not as great as some other facility types, but certainly this incremental improvement was justified.

A couple more, retail and wholesale can definitely take advantage of both the T8 technology improvements and, for that matter, the T5HO high bay lighting systems, and the metal halide improvements and ceramic metal halide. All of these apply in this marketplace, particularly schools. Again, the T8 lamps are predominant in schools, and it was a great application. We could realize the full benefit of the improvements in T8 systems.

These are the table 1-N changes, area category methods. Auditoriums were able to go down a considerable amount. This was largely because of the significant improvements in the T8 systems and the ceramic metal halides, as well as some other potential incidental improvements.

Auto repair, due to T8s; banks, due to T8s. When we added civic facilities the number came out at 1.4, which is consistent with other spaces like it. It also allows a chandelier allowance. Classrooms are able to take probably the biggest downward plunge we've seen yet, and the reason why is because in my opinion the 1.6 number was high. So it's a combination of the super T8 or second generation T8 technology, and simply the value was probably too high from the last go around.

There has been a change that I didn't mention earlier in IES recommendations. The IES revised its design recommendations in 2000 with the ninth edition handbook, and that affected the footcandle levels in this particular calculation, which is part of the reason why it has gone down so far.

UNIDENTIFIED FEMALE SPEAKER: What is the significance of the asterisks on those last numbers?

CONTRACTOR BENYA: The asterisk always means in these that a chandelier allowance is permitted. And you can see, we haven't changed any of those. When we added some facilities, we thought about whether or not it was critical to do that. And so you'll see it occurring in some places and not in others.

CONTRACTOR ELEY: It looks like you've removed the asterisk from malls and arcades.

CONTRACTOR BENYA: Did we? Didn't mean to.

CONTRACTOR ELEY: Okay. Maybe it's an

error with the slide, then.

CONTRACTOR BENYA: Okay. Well, I didn't mean to.

CONTRACTOR ELEY: Okay.

CONTRACTOR BENYA: I didn't mean to remove any of them. That was not something I felt strongly about or I would have made a point of it. So if I did, I overlooked something.

Convention and conference, electrical and mechanical rooms, high bay industrial, precision industrial; all of these, again, the primary -- the same issues, mostly the T8. The multi-family housing commons, 1.0 for multi-family.

For dorms and senior housing it's up to 1.5. Here's the point Charles was making; that asterisk should also appear there.

Hotel function spaces, we were able to drop to 2.0, again for the T8 advantage primarily. Kitchen and food prep, T8. Malls, arcades, atria, these are spaces that can use the ceramic metal halide improvements, pulse-start metal halide improvements, or T8 improvements. Medical and clinical care, again dropping from 1.4 to 1.2, largely because of T8.

Office, as I pointed out before, 1.3 to 1.2, has to do with some T8. Here again, the amount of T5HO being used in these facilities means we couldn't go as far as some other types. Jail is new at 1.0, police and fire station is new at 1.3. Post office is new at 1.6.

And religious worship has only gone down a little bit. And the reason why is in worship spaces in particular, there is still the assumed need to keep both decorative lighting -- ergo, the chandeliers -- and to keep the ability to do dimmable lighting for quasi-theatrical kind of application. More and more churches are utilizing some drama in the liturgy, it's a more modern form of church, but that's church life these days.

And so we do design in the halogen lighting systems for the sanctuary area in particular. So I didn't want to go too far, unless we'd make it impossible to design an appropriate worship environment in church.

Retail sales I felt could take full advantage of both the ceramic metal halide and the T8, although I didn't go crazy on this one, because in this particular retail area category method is not where we see the miles and miles of track lighting today. That's going to come up in the tailored method, which we'll be reporting to you in the future.

So I want everybody to realize that, say, geez, we've got great ceramic metal halide, that should be able to go down a lot. No, that doesn't occur here. That's going to be a real issue when we look at tailored method in a couple of weeks. Finally, transportation facilities at 1.2 is our new number here.

Summary: We felt that ten to fifteen percent, and in some cases 20 percent reductions in a number of the values were very reasonable to make, due to these technological developments over the last seven, eight, nine years.

And the other thing is it has little or no impact on spaces where tungsten sources play an important role. When tungsten sources are used, such as in retail display, this is where the tailored method really comes forward as the method of choice for documenting the compliance of these spaces, and this is where we're really going to have some challenges as we evaluate that in the next phase of our work for the Commission.

CONTRACTOR ELEY: Jim --

CONTRACTOR BENYA: Yes?

CONTRACTOR ELEY: -- could you mention the changes to the control credits that we recommended?

CONTRACTOR BENYA: Yeah, that's a good point, Charles, thank you.

One of the things that comes up whenever you look at section 146 is for many, many years section 146 has included controls credits that allow you to reduce the amount of power from a lighting design, if you utilize certain types of controls. I believe now we're at a point where, since automatic controls are mandatory for all space types, that there is no point in giving controls credits for controls that are mandatory.

So the controls credits that are mandated by the standard, which is the automatic shutoff of lighting in all non-residential spaces now, we propose eliminating. What that leaves is the ones that are optional, the ones that are, for example, automatic daylighting controls, etc.

In doing this, one thing stood out that we hope everybody will take into account. We found that the latest ballast technology that allows us to fully realize that 20 percent savings in the T8 system utilizes low ballast factor ballast to be truly optimal. In other words, the top combination today is a 78 percent ballast factor ballast that draws about 48 watts for two lamps. And when you use the souped-up lamp, the combination has more mean lumens than a standard 60-watt input ballast with an 88 percent ballast factor, driving an ordinary lamp, an ordinary T8 lamp.

And that's where you get that 20-percent savings, that's exactly where you get it. The problem is, you can't get a 48 input watt for two lamps dimmable ballast. So the question becomes what do we do? Do we want to discourage effectively the ability to put in dimming ballast and take full advantage of all that they offer by having the provisions that we do. When we start tightening these screws down, it's going to be harder and harder to not work with these really optimized static ballasts.

The difference in power is the difference between roughly 45 to 48 and 60; in other words, about 25 percent. So what we are proposing, because it won't pass the cost-effectiveness test. You can't say, well, the dimming ballast saves enough energy. Well, it may or may not. Really highly dependent upon the environment in which you're applying it.

We're proposing that the controls credit be applied, it gives 25 percent controls credit for the continued use of dimming ballast. We believe that this will not discourage people from utilizing dimming ballast and some of the technologies that frankly may not save energy but may be very, very important in the future.

CONTRACTOR ELEY: There is no slide on this, but it's on page 11.

CONTRACTOR BENYA: The one condition I really want to highlight is the ability to do demand management. I think most of us see a day where a utility or a Commission may be able to send out a signal to everybody that says please dim your lights ten percent, you know, we need a little extra power on the grid. We certainly have experienced a time when that might have been handy to have been able to do.

And lighting is one of the very few things that you can dim ten percent or 20 percent and not significantly affect productivity. Try turning down computers ten percent or twenty percent and it just doesn't work. And so we -- I think that we should give that ability for a designer to put in a dimming ballast for a reason that may not in any other way pay for itself, so that we in the future find ourselves with a building stock equipped with ballasts that will allow these technologies to be implemented, without that additional burden of first cost.

I'm pleased to report to you that the cost differential of dimming ballast may go down very big time very, very soon. I was speaking with people at Lutron last week who, of course, make an expensive set of dimming ballasts. And they are prepared to announce a big breakthrough in the cost of dimming ballasts that will make the cost go way, way, way down compared to where they are today.

I'm very enthusiastic about this type of development, and it may make the discussion we're having right now obsolete within a very few years. But I believe that between now and the next time we get together on the standard, it would be prudent to encourage the use of dimming ballasts, and I believe that the 25-percent number is justified because of the power difference between what I can get in a variable ballast, factor ballast and the most efficient ballast I'm going to be using three years from now.

WORKSHOP CHAIR ALCORN: Are we ready for some questions, Jim?

CONTRACTOR BENYA: Yes.

WORKSHOP CHAIR ALCORN: Okay.

CONTRACTOR BENYA: Hi, Gary.

PG&E REP FERNSTROM: Hi, Jim. Gary Fernstrom, Pacific Gas and Electric Company.

Jim, how do you differentiate between the big box retail, places like Costco, Home Depot, Office Max, CompUSA, and more specialized retailers like Macy's in the standards? Because it seems to me the lighting requirements are quite different, and different lighting power densities might be called for in those circumstances.

I see you added some additional categories, but I didn't see that particular one as one of them.

CONTRACTOR BENYA: Good question. From my experience, and you could check with Bernie Bauer on this too, because, you know, Bernie does a tremendous amount of retail lighting, Title 24's tailored method, probably the most extensive portion of the tailored method is the calculations with respect to retail. And, again, from my experience over many, many years, the retail lighting that involves the higher end -- the Macy's, you know, Nordstrom's and folks like that -- generally involves a combination of display lighting, track, model points and things like that, and ambient and general lighting, valance lighting and some of the other things that are a part of that style and that look.

Most of the time you have to demonstrate compliance of those projects using the tailored method. The tailored method tends to provide -- I have probably justified, recently completed a project for Nike in Orange County, and we're doing another store for them in Beverly Hills, and those stores were in the neighborhood of about 3.2 to 3.3 watts a square foot. And the only way you can justify those is with the tailored method.

We have a responsibility to come back to this group in a few weeks with a proposed revised tailored method. One of the complaints we've heard many times over about the tailored method is it's so complicated and it's so hard to do. We've heard this from a number of sources. I was even one of the people who proposed it. Yeah, I think it can be made simpler.

I don't have the answers yet. As a matter of fact, I start the work this week, and by Friday I'm supposed to have an outline of where I think this thing is going. But as part of that work area, we'll be revising the power densities as well for the tailored method, so, in other words, it's in the tailored method.

PG&E REP FERNSTROM: Okay, well, I wasn't so much worried about the tailored method as I was optimistic that LPDs could be lowered for big box retail applications from what even now is recommended, given the predominance of pulse-start metal halide or high bay fluorescent lighting in those applications. And the improvements and efficiency that you pointed to with those sources.

CONTRACTOR ELEY: The number is 1.8 right now; it went from 2 to 1.8.

CONTRACTOR BENYA: You know, we harvested that. We did, it's 1.8.

CONTRACTOR ELEY: So, Jim, you're saying this 1.8 is appropriate, then, for the big box retail?

CONTRACTOR BENYA: Gary is bringing up an interesting point. You know, it's one of the challenges of all of these -- I just want to be -- yeah, 2 to 1.8 -- one of the challenges of all of these is to, you know, the first question is has lighting design for big box changed since 1998? And do we do something different? If so, what do we do different?

The one thing I can say we definitely do different is we use pulse-start today. Pulse-start allows as much as a 20-percent reduction. So if we were just to say pulse-start, then we go from two, take 20 percent of that, and you could say we go down to 1.6. And --

PG&E REP FERNSTROM: Well, plus you have the better lumen maintenance.

CONTRACTOR BENYA: Well, that's included in the calculation.

PG&E REP FERNSTROM: Okay.

CONTRACTOR BENYA: Lumen maintenance is part of the calculations.

There is probably going to be a bigger change when the electronic ballast actually comes out for HID. Halophane now is saying they have one, you know, and they're saying the lumen maintenance numbers are going to get our attention.

When we did the modeling, though, I felt comfortable going from 2 to 1.8. I don't think I felt comfortable going from 2 to 1.6. And I think it's because -- the reason why is because there are so many different source types. I didn't feel like just buying into the notion, to go with just the pulse-start alone, that we'd just drop the number a full 20 percent. Because it's not true in all wattages.

It doesn't really occur below, you know, 175 watts. And a 150-watt lamp has always been pulse-start, so it doesn't happen there. And it doesn't happen below 150 watts. So it only starts to occur in the higher wattages.

And a lot of big box retail is done at 150 watts for that reason, because the lamp had better color and so on. There are some big box stores, Best Buy and folks like that, that have got higher bays, but when you're in some of the lower bay spaces, you know, 150-watt lamp is also used. So it kind of depends.

CEC STAFF SHIRAKH: If I may chime in,

this is Mazi Shirakh, S-h-i-r-a-k-h, with the Energy Commission.

If you look at the current assumptions for retail, it's 85 percent of the lumens are coming from T8, T5, very efficient sources. Only 15 percent are coming from halogen IR. So even if you replaced T8 and T5 with pulse-start metal halide, you're not going to gain much.

Plus the fact that --

PG&E REP FERNSTROM: Well, Mazi, I don't see any halogen IR in Costco, Home Depot, Office Max --

CEC STAFF SHIRAKH: But I was getting to that. Fifteen percent is coming from that, but Costcos and Home Depots have higher room cavity ratios, so we have to consider that too. So there is a tradeoff in here, even though 15 percent here is allowed for halogen IR, in big box stores it's compensated by the higher room cavity ratios.

So given that, I think the 1.8 is a fairly reasonable number. And, as Jim pointed out, I mean, this is the basic number for retail, and it's basically for that type of application. And anybody who wants to do high-end retail, then they have to go to the retail method -- I mean, I'm sorry, the tailored method.

CONTRACTOR BENYA: Well, let me just throw out a couple of specifics on retail. The way the model went, 70 percent of the space was assumed to be task, 30 percent was assumed to be ambient. Excuse me, 70 percent of the space was assumed to be task at 70 footcandles. Twenty percent was assumed to be ambient at 30 footcandles, and ten percent was assumed to be some sort of display at 100 footcandles.

In the model that we ran, we assumed lighting systems, all the lighting systems were, as Mazi pointed out, most of them were T8 and T5 lighting systems with halogen IR being 15 percent of the total and 85 percent was T8, T5. Seventy-five percent of the total lighting systems were direct lighting systems, not indirect. We didn't do that. We didn't go in the indirect direction. Ten percent are directional T8 and T5, you know, those wall washers, and so 15 percent was directional halogen.

Coefficient of utilization of the general lighting systems, 80 percent, very, very high, because it was assumed to be a fairly efficient lumenaire for general lighting. The directional lighting system was actually assumed to be valance. And the way the numbers work out, in order to do that the maximum theoretical -- the minimum theoretical power density was 1.75.

So, you know, even if you used pulse-start metal halide, the numbers wouldn't change. Now, you could argue that the lighting levels are high, but those are pretty consistent with not only the established practice but with the IES handbook today. So the whole spreadsheet on this is pretty solid.

Now, could you design it for 1.6? Of course, you could. As a matter of fact, as the Heschong Malone Group's research has shown, many times the standard is beaten by an average of ten percent. So, you know, yeah, you could do it, but you'd have to drop your light levels a little bit, that's all. And I don't think the standard should be set at a low light level, I think this is a real good number.

So I like the number of 1.8, I feel good about that as an area category. Keep in mind, this is an area category. This is only for the sales area. You have a lower area at the back of the store.

SPEAKER MAHONE: Hi, I'm Doug Mahone with the Heschong Mahone Group.

In general, I think this is great. I have a couple of questions and comments. One is sort of a methodology suggestion, actually. You mentioned this data that we got. I happen to be one of these guys who believes that survey data can provide a lot of useful insight, and the non-residential new construction database, which utilities have spent several million dollars developing over the last few years, surveys of over a thousand newly built buildings, has a lot of very building-specific data on most of these area categories.

And I would like to sort of see a comparison between these kind of abstract theoretical calculated values and what the survey data is telling us about what's going on in the field. I think in general what it will show is that a lot of buildings out there can already meet these lighting power density numbers, so I think it will strengthen the case, and I think it will also provide kind of a useful triangulation. There is a lot of detail and a lot of judgment built into this that I think could be improved by, you know, looking at the actual data out there. So that's more of a comment, I guess, than anything.

Another thing I would like to point out is that this non-residential new construction data set has been and can be used to develop a statewide estimate of the energy savings that will result from these changes. And I would hope at some point in the process we can get the resources together to run these numbers through the data set so that we can talk with some confidence about what the net statewide savings, not only in energy but in demand, would be from implementing these new numbers.

CONTRACTOR ELEY: That's tasked. That's one of our tasks.

SPEAKER MAHONE: You're going to do that?

CONTRACTOR ELEY: Yes.

SPEAKER MAHONE: Good.

The third question I have is about the new area categories that you've got. You didn't provide a comparison between the current area categories and the new ones, and I can see that there is not an existing category of the same name to compare it to, but the current area category method has rules for how you would like these spaces, under the current space definitions. So even though we don't have an area category now called civic, we do have other area categories that would be applied if you were designing such a building.

So I think it would be useful, and a useful comparison to compare how the current area categories, whatever they're called, would apply to the new categories that you've developed.

And then the final question is about this 25 percent lighting power credit for the dimming ballast. I guess I don't yet have an opinion about whether or not that's a good idea, but I wanted to observe that this is a -- what you're recommending is a departure from the philosophy of existing lighting power credits. Existing lighting power credits are created on the presumption that by putting in this device, an occupancy sensor, for example, you're saving an amount of energy equivalent to a percentage of lighting power reduction that you're allowing through the credit.

CONTRACTOR ELEY: That's what this is

based on --

SPEAKER MAHONE: And if I understood what you were saying, that's not what this is based on. You're saying that in order to not discourage the use of dimming ballasts, we have to give them a 25-percent credit because they're inherently less efficient than the fixed ballasts that they're replacing.

And you're recommending that we do that on the basis of a policy choice, that we want to encourage the technology. But I don't think we're claiming that it's going to save 25 percent lighting power. So, you know, I think it's a departure from the way we've awarded lighting control credits, and it's based on a policy choice to encourage that technology. So I could say I don't think I've got an opinion yet about whether or not that's a good idea, but it's not going to save 25 percent energy, I don't think.

CONTRACTOR ELEY: Yeah, I understand what you're saying. Yes.

CEC STAFF PENNINGTON: I have a question about that. Do you have an estimate for how much can be saved through dimming, relative to the increased wattage used by that kind of a ballast? Do you have a net number that would be an energy number?

CONTRACTOR BENYA: Wow --

CONTRACTOR ELEY: Well, if a different ballast is used --

SPEAKER MAHONE: I can give you a suggestion how you could do that. We've just completed a study for the utilities on measured behavior of people using bilevel switching. And we've got data from a number of buildings, as to what the energy savings from the voluntary operation of users for bilevel switching, which is probably the closest to what you'd have here, if you're talking about just a lighting system with a dimmer. I mean, it's basically doing the same thing as bilevel switching, although with a different -- with a slider instead of a switch.

So, you know, we could use those numbers as estimates. They show open office savings on the area of ten percent from bilevel switching, savings of about 15 to 20 percent for private offices, and I've forgotten what the numbers are for classrooms and retail. They're bigger for retail, interestingly enough.

So that might be one way to get at it.

CONTRACTOR BENYA: Let me just expand upon that a little bit. When you put in a dimming ballast, you make it possible to introduce controls systems you can't have with a non-dimming ballast. You have manual dimming, you have tuning, you have daylight dimming, you have a number of very desirable lighting controls features, but if you don't make the investment in the ballast, it kills the idea. The ballast has been the obstacle.

It isn't the controls system that's costly, it's the ballast. The incremental ballast cost is the problem. Well, it gets worse if you also pay a ballast penalty in your watts, okay, and this is what it boils down to. It's a ballast penalty -- If we're going to require people effectively to build their designs around high-efficiency static ballast wattages, the dimming ballast in my opinion will not, for the foreseeable future, be sold in the same increments of low ballast factor or reduced ballast factor the way static ballasts are.

So it kind of sticks me. It's like, well, if I want to meet my Title -- and it's not just Title 24, because keep in mind that savings by design and many other programs utilize the Title 24 values for incentives and other things. So, you know, it's a double problem. By putting a dimming ballast on, I'm paying a penalty for putting that thing in.

And what I want to do is I want to eliminate that penalty until we get to the point where we can do a better job. Personally, I think there will be a day we will require dimming ballasts. That may even be in the next code revision. I think it will be. If Lutron is right about what they're telling me, it will be.

But for this round, I think there is a penalty for putting in a dimming ballast and I want to eliminate it. That's all.

CEC STAFF PENNINGTON: So what's the power increase of going from a static ballast to a dimming ballast?

CONTRACTOR ELEY: Well, 48 to 60, if the dimming ballast is at full power.

CONTRACTOR BENYA: Between 45 and 48, and it really depends upon which lamp you put in that socket. But the key is that the -- that's why I picked the 25-percent number, because I felt it was more representative of that difference.

CEC STAFF PENNINGTON: Right.

WORKSHOP CHAIR ALCORN: Okay.

Tom Trimberger has a question?

CALBO REP TRIMBERGER: Yeah, this is one of the easiest things to really enforce. The watts per square foot, it's pretty simple, you know, and we can all see that it gets racheted down.

I would encourage in subsequent manuals and explanations of changes to standards, tell how we got there. These are the products, the new products, A, B, C, D, E that are showing, you know, the cost benefit is there and that's why, that's something people can use to reach the standards.

A couple things on definitions. We've got something in police or fire stations, includes conditioned garages and maintenance areas. If we're going to be looking at lighting power in unconditioned spaces, I don't know why we'd need to look at police or fire station defined as a conditioned garage. So that's just something you guys might want to look at.

Also, the definition for senior multi-family housing, and you've got a little bit of a list of people and tried to meet three of those: skilled nursing, assisted living, Alzheimer's care, hospice, and common dining. So you're really not trying to say, okay, these senior apartments, facilities, that's not going to meet your definition of senior multi-family housing?

CONTRACTOR BENYA: Yeah, and see, that's a real good comment. This one in particular is the one that's the most difficult.

CALBO REP TRIMBERGER: It's very restrictive, I would think, to get three of these.

CONTRACTOR BENYA: Well, see, having been through the wars of Title 24 enforcement issues for 20-some-odd years now, I think we've all learned a lot of lessons upon the issues inspectors face in the field. I think our biggest concern in this one, and Mazi and I exchanged letters and memos for a while on this issue, but the problem is that we can see this being gamed, you know, somewhat inappropriately.

CALBO REP TRIMBERGER: Right.

CONTRACTOR BENYA: And --

CALBO REP TRIMBERGER: People trying to say it's senior multi-family instead of just regular --

CONTRACTOR BENYA: Yeah, you know, oh, this is senior housing, we get to use all this wattage, and then you come to find out, well, you know, they had one family of seniors move in to one end of the block, you know. Big deal.

When I have designed these facilities, it's been my experience that if you have Alzheimer's care, for example, what that involves from a design standpoint is a very specialized type of facility. Likewise, hospice; likewise, well, all of them, really.

CALBO REP TRIMBERGER: Right.

CONTRACTOR BENYA: And so generally speaking, the direction of the type of facilities where it is absolutely senior housing, it has these things. These are generally part of the complex, because people want to go from their apartment, and if they get really sick, to one of those other facilities, hopefully to come out, and they're going to come out one way or the other.

And, you know, that's part of the living experience of this type of senior living environment. And I've seen these facilities all over the country, I've studied them, you know, fairly thoroughly in the design phase. I'll tell you, it rings pretty true. You usually have all of these, in fact.

The common dining, for example, is important because a lot of these people can't cook for themselves any more. And light levels in a common dining area are 50 footcandles, according to RP 28. So that's why.

CALBO REP TRIMBERGER: Okay. So, you know, where there's -- this is one of the things that is getting real common is senior housing, and senior apartments, living. You know, whether it's -- oh, I forget what they call it, up from Rocklin, you know, there's --

UNIDENTIFIED FEMALE SPEAKER: Congregate care facilities.

CALBO REP TRIMBERGER: -- huge facilities, there are small facilities, but just a regular apartment facility that's geared towards seniors, and with rules that says you've got to be 50 or something to get in.

CONTRACTOR BENYA: Doesn't apply.

CALBO REP TRIMBERGER: Doesn't apply, okay. That's where I wanted to go now.

CONTRACTOR BENYA: This is for -- See, you don't need the high light levels --

CALBO REP TRIMBERGER: This is more for the clinical --

CONTRACTOR BENYA: -- for people who want to be totally independent and live in a totally independent environment and don't have all of these provisions --

CALBO REP TRIMBERGER: Okay.

CONTRACTOR BENYA: -- they don't need this. What we're talking about is facilities where people that are in their 70s, 80s, 90s, 100s live, where they have these special provisions, and where the higher light levels are truly necessary.

CALBO REP TRIMBERGER: Okay.

Lastly, you know, you mentioned a little bit about remodels, where the lighting systems don't last, because the retail place will go out of business and another place come in, a lot of times you want to reuse the same lighting, change the wall arrangements around. And a lot of those cases, just because of the different wall configurations, they can't really compare and say we're reducing the lighting, they're just saying, okay, we're going to make this comply already, but we want to reuse a lot of the fixtures.

CONTRACTOR BENYA: Well, I realize that reusing --

CALBO REP TRIMBERGER: How does that happen, or --

CONTRACTOR BENYA: Well, it really depends tremendously, and this is where, again, we talked about the importance of a report on the tailored method that's coming up. The tailored method, its strongest suit in my opinion has always been its support of retail. And it does a very good job in doing that.

And we're going to be looking at it, because we want to continue to do a good job without causing any problems. This particular light source raises a very challenging issue, and the only reason why I brought that up is because we're going to try and do our best to walk that fine line in coming back with our recommendations as we go through the next phase of the tailored method, to try and make sure that we don't create a real serious problem, relying too much upon something that is still, you know, it's a high cost of entry with this technology.

CALBO REP TRIMBERGER: Yeah, I think even -- and, you know, I'm not talking about the

Macy's, but the strip mall retail, where an office leaves and a little retail place comes in or vice versa, where they're going to want to reuse fixtures, where before they were allowed to use 1.4, now it's 1.2 or something, we're just rationing that down. And they're going to be trying to use the same fixtures.

CONTRACTOR BENYA: Well, they can use the same fixtures, but when you change the occupancy and you change the demising laws, you've got to pull some permits. And you have to -- As part of your permit, you're going to redo your Title 24 calculations.

CALBO REP TRIMBERGER: Okay. That's exactly it. They'll redo the calculations and they'll yank some lights out. Are we going to be getting them to dim, or is this not a big enough change?

CONTRACTOR BENYA: Oh, no, the standard we are convinced, and these calculations prove it, permit IESNA recommended lighting levels under every occupancy condition. I have no question in my mind about that.

And if you're providing, and typically in retail you will provide more than 50, typically up to about 50 to 70 footcandles for task illumination, and when you go to office occupancy it's 30 to 50. Reducing your lighting by the ratio of the watts per square foot even is very, very appropriate.

CALBO REP TRIMBERGER: Okay. I don't know that I'm saying this properly --

CEC STAFF PENNINGTON: Well, I think the question is if you're going to use exactly the same equipment in this remodel, but now you have two-tenths of a watt per square foot lower requirement, is that an issue?

CALBO REP TRIMBERGER: And the designers may not -- you know, they may be the installing contractor and not a lighting professional, and they're trying to make these existing lights work because that's what's in the budget.

Is that going to leave them unhappy with the space if they're not bright enough?

CABEC REP FARBER: Excuse me, could I say something?

WORKSHOP CHAIR ALCORN: Go ahead.

CABEC REP FARBER: Gary Farber of Farber Energy Design, representing CABEC.

I think your question has to do with reusing existing light fixtures and a change of occupancy and the LPD level might be reduced. Section 149 allows the wattage to be maintained, as long as you're not changing out over 50 percent of the light fixtures, so doesn't 149 pretty much cover that problem?

CALBO REP TRIMBERGER: If you're going from office to retail or retail to office, I don't know that that --

CONTRACTOR BENYA: It doesn't really affect occupancy.

CEC STAFF SHIRAKH: As long as --

CONTRACTOR BENYA: The occupancy is not triggering it.

CEC STAFF SHIRAKH: He is correct. As long as you don't increase the connective wattage or change more than 50 percent, then they don't have to show compliance.

CALBO REP TRIMBERGER: All right.

CONTRACTOR BENYA: Gary actually brought that up as a question on a previous, what was it, a hearing or a previous set of comments. He brought up that same question, and we did say, yeah, you know, it might be necessary to have something have to occur in case of a change of occupancy type. That is not in the standard section 149 currently, but you're absolutely correct, if you don't change the lighting system at all, you just move out one occupant and move in another, yeah, if you don't change the lighting system, you get to keep what you got.

CEC STAFF SHIRAKH: In the 2001 manual, we've made a lot of improvement to that section, to that language.

CALBO REP TRIMBERGER: Okay. Be that as it may, having enforced this, a lot of times that new number, this table 1-M lights -- LPD is your target. And whether the designer is sophisticated enough to know the rules and everything, they're going to move into a space, they're going to say, okay, I've got all these existing lamps I want to reuse, and I've got something I'm going to try to hit.

Is it going to -- You know, if they take the old lamps and use the new LPDs, are they going to be unhappy with the lighting? I'm not a professional, I don't know, I --

CONTRACTOR BENYA: No, Tom, I understand your question now a little bit better.

Very simply, if you move into a space with existing lighting systems, and the lighting power in that space, and I'll go you one step further. Let's say you walk into a building that's got an existing two-by-four lighting system, two-by-four lens fixtures, and you happen to be going into a space where, you know, they're sitting there on the floor, all right. You're going to put them back up. They are not going to be the technology that's been used to do these calculations, you're correct on that.

You'll have a choice. The choice will be to be -- to leave them out so that you don't necessarily have to improve them, or you could improve them and get the full benefit of it. The improvements we're talking about are mostly lamp ballast things. You can take the two-by-four -- You could take the strip lights in this room and you could upgrade them. It wouldn't be that expensive to do. And if you are moving a new tenant into a new space, the improvements in energy efficiency would be worthwhile to make.

So you kind of have your choice. If you want all the lights you can get, you improve the lighting system by changing the lamps and ballasts. If you can get by with what you've got, you get by with what you've got. But in no case are you going to be that far off. You know, if the IES recommendation is 30 to 50 footcandles, you're going to be able to get pretty close to 50, even if you're using T12 equipment, if you're very thoughtful about it.

CALBO REP TRIMBERGER: Okay.

SPEAKER MAHONE: Yeah. In fact, a lot of times when that happens you'll have an existing space that has an older lighting system with higher lighting power density. They're allowed to keep that higher lighting power density.

So in a lot of cases, because of what's there, they'll have more lighting power than if they were doing a brand new remodel of the space.

CALBO REP TRIMBERGER: Well, they are, but like Jim said, all those fixtures are lying on the floor in the corner because they've been pulled out of the ceiling already. And they can't tell us what the existing lighting power was. They know they've got 44 of these fixtures lying there, but the answer is they can be rewired to new ballasts and such --

SPEAKER MAHONE: Usually, usually.

CALBO REP TRIMBERGER: -- so it's not -- they can reuse some of what they have.

CONTRACTOR BENYA: They could probably -- If it's fluorescent, they could probably reuse it, even if it's 30 years old, by putting in this new technology. It's off-the-shelf stuff. It's inexpensive. As a matter of fact, there's a whole industry of retrofitting that exists because the stuff is such an improvement.

CALBO REP TRIMBERGER: And sometimes they get permits; I've seen them.

CONTRACTOR BENYA: Yeah. Wouldn't that be amazing?

CEC STAFF SHIRAKH: I just wanted to respond to one of your comments on the police department. You're quite correct on the conditioned garage. That should not be there. In fact, I suggested that be edited, but some are still in there, so we're going to have to take that out.

CALBO REP TRIMBERGER: Well, I don't know why a garage in a police department needs a different wattage as to whether it's a garage of somebody else.

CONTRACTOR BENYA: Let me tell you why. I specifically wrote that in there. Have you ever been in a firehouse?

CALBO REP TRIMBERGER: Yeah.

CONTRACTOR BENYA: Okay. What does the garage in a firehouse look like? Well, they've got a big piece of apparatus in the middle of it called a fire truck. All around it they store all kinds of technical apparatus and storage areas and everything else, they do a lot of work on the equipment, including technical work on machinery, and they do a lot of cleaning and other things, sometimes involving very small stuff, sometimes involving big stuff too.

But the room is full of absorptive surfaces, particularly the fire truck, and you actually need a relatively high lighting power density in there to get enough illumination to get light down and by the sides of the truck and around the truck so you can actually work on it. It's actually more difficult than an automobile service area, because usually it isn't as big, you don't have as many bays. The room cavity ratio is usually terrible, so I very carefully thought that one through.

The reason why I said conditioned is because when they just park the vehicles, it's in an unconditioned space. But when they work on them, maintain them, and all the equipment that goes with them, and this not only includes fire trucks but emergency vehicles of all kinds, they need it.

WORKSHOP CHAIR ALCORN: Great.

Gary?

CABEC REP FARBER: Great, thanks. Gary Farber, representing CABEC. And I have a lot of questions, so hopefully I'll have a little bit of time.

First, occupancy sensors. I wasn't clear on why you want to eliminate that credit. I understand that to some degree it coincides with the shutoff, but it doesn't fully. It does yield further savings. So whether we have some credit, where we're not double-counting the end-of-the-day shutoff savings, but we're getting some credit for the middle-of-the-day savings that would accrue.

CONTRACTOR BENYA: Because it's now mandatory. You have to do one or the other. You either have to do -- You have to do some sort of automatic shutoff.

CABEC REP FARBER: Right.

CONTRACTOR BENYA: Motion sensing or time-based.

CABEC REP FARBER: Well, what I'm saying is that doesn't motion sensor give you more savings than just the end-of-the-day shutoff system?

CONTRACTOR BENYA: It depends upon the building type, the occupancy type, and a lot of other factors. It does in certain building types and it makes no difference in others.

For example, if you have an open office area that has got a pretty rigid work schedule, the only energy savings that might be gathered tends to be after 6:00 p.m.

CABEC REP FARBER: Sure.

CONTRACTOR BENYA: The difference between a motion-sensing system and a time-of-day sweeping system is you might save a little bit of time after 6:00 p.m., but definitely not on peak. The peak on hours are exactly the same and all the motion sensor manufacturers will tell you that.

CABEC REP FARBER: Sure. Might it be worth considering maintaining a credit, and maybe a different credit than the current one, but maintaining some credit for, say, private offices and some other smaller types of uses, where there would be credits, you know, savings during the daytime?

CONTRACTOR BENYA: Well, again, some sort of device is mandatory. It's actually cheaper to do it with a motion sensor than it is with an automatic time shutoff in a private office. And I see them going into all spaces because of that, so people are already putting them in, why do we have to give them credit for it?

SPEAKER MAHONE: Yeah. For the AB970 round, when we put in the changes to requirements that Jim is just referring to that basically requires an automatic shutoff, we seriously considered dropping this occupancy sensor credit back then for all these reasons that Jim is talking about. You know, we backed off just because we didn't want to do too much too fast, but I think it's a good idea.

And, as Jim says, we're expecting that, in fact, most people will find the use of occupancy sensors to be the easiest way to meet the current requirements.

CABEC REP FARBER: Okay. Well, if that's the way the market is going, I could understand it. But I just don't want to discourage it, since I think it will save at least a little bit more energy, why discourage it.

CONTRACTOR BENYA: Believe me, people are making the right decisions now.

CABEC REP FARBER: Yeah.

CONTRACTOR BENYA: They have to choose between the two, and the one that's most cost-effective is the one they'll use, and that's what we want them to do in the first place.

So I don't see the need to have the required -- Now it's required. Let's just go on to something else.

CABEC REP FARBER: Okay. Second, on religious facilities, there was very little drop, a small drop because of -- the need for dimming. Is dimmable compact fluorescent still too pricey to consider as an option?

CONTRACTOR BENYA: You can't light a church with a compact fluorescent.

CABEC REP FARBER: Okay.

CONTRACTOR BENYA: You can't.

CABEC REP FARBER: Okay.

CONTRACTOR BENYA: You know, generally the volume is so great and the need for wattage and beam concentration is too high. And the other thing is the drama in liturgy is increasing, and there is still a need for doing higher lighting in the sanctuary to the point where we feel that you can't quite get there yet.

CABEC REP FARBER: Okay.

CONTRACTOR BENYA: And the other thing is a cost justification test is going to be a little difficult, because the number of hours tends to be pretty modest. And churches, because of their limited funding usually, are very careful about the use of their high-powered lighting. I've seen a real trend in that area too.

CABEC REP FARBER: Right, right. Does this Lutron development, does that cover smaller compact fluorescent ballasts as well?

CONTRACTOR BENYA: I don't know how far it's going to go. I know it's probably -- we're going to see it in T5 and T8 first. Probably T5 twin and some other, you know, major sources, but I would guess that they would trickle it down into the higher wattage compacts -- 32s, 42s, 26s and stuff like that eventually. Sooner rather than later.

CABEC REP FARBER: Okay, great. Yeah.

I wonder if we could have a little discussion about categories and where they're appropriate, which table, complete building versus area, because I've got some concerns about that which have been expressed for some time, like retail.

I think retail is the only complete building category on that list where there can be a wide range of ratios between sales and storage, where those two uses have a wide disparity in the LPDs. And I'm not sure that there's anything else on that list of complete building where you've got that same kind of issue. You know, where we may have a wholesale store which is 90 percent storage and ten percent is a tiny display area and pickup station, basically.

And I just wonder whether we really need to have a retail/wholesale complete building number at all. I guess we could address that first and then I want to get into some of the other area category ones.

CONTRACTOR BENYA: Well, the only thing

I can say is your point is a really good one, that when one creates a model for a whole building, you assume certain percentages of space and they're done on some sort of statistical basis. However, that statistical basis, as you put it, can be wildly off in the area of a store.

Some stores are 100 percent front of house and some stores are five percent front of house, and everything in between. I think this is the first time I can remember us having had this discussion, but it's certainly an interesting one. I don't necessarily feel it's necessary to do anything about it, but it's -- you know, it's food for thought.

CALBO REP TRIMBERGER: I would encourage -- Tom Trimberger, CALBO. I would encourage keeping it there, you know, as -- If you can have a simple way of getting there for people, rather than break it up into multiple spaces and categories, then I would do that. It may not be 100 percent precise or accurate, but it gets you there.

CONTRACTOR BENYA: Well, your point -- That's probably the reason why we wouldn't want to do it is because right now I feel that it's clear, enforceable. The coefficient can look at it and say it's a store, boom. And we're not forcing that individual to make a decision, a judgment in many cases.

And, you know, I agree with you, I think if I were an inspecting authority, the last thing I'd want to have done is ask me to make a lot of judgment decisions.

CABEC REP FARBER: But, you know, the reality is under the area approach, you're going to have a retail area, a storage area, and possibly a corridor and rest room area. So you've got three numbers instead of one. It's really not a big deal.

And if people can't handle that, they probably shouldn't be doing this work, but --

CONTRACTOR BENYA: It's food for thought.

CALBO REP TRIMBERGER: Can I -- I'm going to love that one. If you can't handle it, you can't be doing this work, sorry. I'll tell people all the time.

(Laughter.)

CALBO REP TRIMBERGER: You came for a permit, I told you you have to do it, and if you can't handle it, you shouldn't be doing it.

CABEC REP FARBER: We're talking about three areas and three LPDs, you know, I mean -- It shouldn't be a big deal. But anyway, that's what --

The other thing I wanted to talk about is some of the area categories. We've got a lot of area categories, we've got -- I mean, we have this existing one, bank, financial institution. And I think one problem I see is that we need to have better names for these things, because they often sound like they're referring to a complete entity rather than a piece of it. And I think that's also true for many of the new ones. They sound like they're for a complete entity and sort of -- for a piece of one.

And I don't have suggested names, but I think we need to think about that. But I think beyond that, I was wondering why do we -- do we really need area categories for banks and police and fire stations and post offices and transportation facilities? I'm wondering whether, conversely to my argument on retail, whether those wouldn't make sense being in the complete category, which would make CALBO's job a whole lot easier.

In other words, are those facilities, if we looked at the range of designs in those facilities, perhaps the range of the various areas aren't that much different that we couldn't come up with a model to suffice for a complete building and just make it easier. Because I think that what we're doing with these area categories, we're taking enough pieces of certain area categories and saying, well, that gets some special attention, but then you've got these other ones that don't, and I think it's getting very, very confusing, frankly, and I'd prefer not to see all these new area categories. I'd rather see them in the complete building category.

CONTRACTOR BENYA: Well, there are two reasons. First of all, I disagree in the suggestion that these facilities are sufficiently homogeneous, that one city hall is the same types of uses and everything else as another. There are, in fact, lower light level requirements for certain space types and higher light level requirements for others.

If you had a federal building with a lot of courts, for example, you would have a whole different power requirement than if you had an ordinary city hall with a police station. And once we started thinking about it, we thought, you know, this makes a lot of sense. We really don't have definitions for these spaces. What do you call a police station? Is that a lobby? You know, and we started saying it really does have a kind of a special use and a special need to figure out. So that was part of it.

The other part of it is, frankly, something we've heard time and time again from other folks around the country -- in this case, NEMA -- which is to try and have the same definitions in Title 24 and ASHRAE IES 90.1 '99, wherever it makes sense. And these specifically came out of 90.1 1999. So we have a national precedent as well as, frankly, a very practical one.

So I disagree with your comments on that, Gary. I think many of the other comments you've provided, though, have been really good food for thought, but this one I'm -- I think we did the right thing.

CABEC REP FARBER: Okay. What about the naming? Do you think we can get names that give us a better sense that we're not talking about the entire entity? Because I think there's going to be a whole lot of confusion. There already is with banks. I mean, you say bank and financial institution, it sounds like you're talking about the entire bank. And yet, if you read the manual, you're not supposed to apply it to the entire bank, but we don't know what areas you are supposed to apply it to.

CONTRACTOR BENYA: If you read the standard and you read the definition, it is quite clear. It says it is, and I'm paraphrasing here, but it says it's areas where, you know, banking activities, including money changing hands, etc., occur. And it does not include the common areas, it does not include, you know, areas that fall under other definitions.

And there is a little bit of a nomenclature issue here, I understand what you're saying. But anyone who understands the standard and how it works, you know, it very carefully says these areas, you've got to go by the area of the building with that type of use, not by the -- you can't do the whole building that way.

CABEC REP FARBER: Yeah. You call

something post office, and most people think of a post office as being the entire post office, so I wonder if we couldn't say --

CONTRACTOR BENYA: What are you going to call it, postal handling facilities?

CABEC REP FARBER: I don't know, I'm just saying maybe we should put our minds to it and kind of try to come up with something that just gives it the sense that we're talking about certain parts of it, certain special areas of it and not the entire thing.

CEC STAFF SHIRAKH: We've tried very hard with the definitions to make it clear what areas it covers, so, you know, if anybody, like on the financial institutions, banks, under the definitions in area categories, it specifically says what areas are covered, what are not.

CABEC REP FARBER: Well, for instance, on banks, let's say we assume this process is going to be dealing with, you know, all these definitions, wherever there might be holes in it, on banks. I don't know whether the space behind the tellers, where there are typically desk, whether that's office or that's part of the bank/ financial institution.

CEC STAFF SHIRAKH: Good that you mentioned that.

CABEC REP FARBER: I don't know whether the part in front, where there are waiting lines, where the customers are, and there's little kiosks where customers are filling in things, whether that's bank/financial institution, or --

CEC STAFF SHIRAKH: Well, under the new LPDs that Jim is proposing, both the financial part of it and the office are 1.2 watts per square foot, so --

CABEC REP FARBER: Oh, okay.

CEC STAFF SHIRAKH: -- it doesn't really matter what they're called.

CABEC REP FARBER: I see, okay.

CEC STAFF SHIRAKH: So that's sort of --

CABEC REP FARBER: We've taken care of that problem.

CONTRACTOR BENYA: If anything, we're trying to get closer better definitions so, again, so the inspecting authority is not making a great big judgment call. We don't want to put them in the position of saying, well, is a banking area like an office or a classroom or what it is? It says banking right there, and you don't have to think much further.

CABEC REP FARBER: Do you believe in banks that there also is too wide a disparity in the designs between the various functions of the bank with different LPD requirements that we kind of come up with a complete building number instead?

CONTRACTOR BENYA: Well, the same thing applies. You know, we've tried to follow a very practical path. We've compared our numbers to 90.1. Our numbers are the same or lower, which means we're doing the right thing, in my opinion.

We tried to use the same definitions, the same names of spaces and everything else. So at some point, yes, you can always improve something, but is it clear enough? And I think it is.

CABEC REP FARBER: Yeah, great.

Would it be okay if I just talk briefly about display credits, since you're going to be dealing with --

CONTRACTOR BENYA: Actually, number one, due to the fact that we're running a little late and I have an airplane to catch this afternoon, I'd prefer to give you my card and say call me.

CABEC REP FARBER: Okay, that's fine.

CEC STAFF PENNINGTON: Yeah, and, in fact, that's not really the topic of today's meeting, so --

CALBO REP TRIMBERGER: Yeah. Come back May 30th, Gary.

CABEC REP FARBER: Right. Isn't May 30th regarding tailored?

CEC STAFF PENNINGTON: Yes.

CABEC REP FARBER: Because my problem has to do with allowing credits for other lighting compliance matters.

CEC STAFF SHIRAKH: He wants them for complete building and area category as well.

CABEC REP FARBER: Or at least for area category, but I think it's something we ought to discuss.

CEC STAFF PENNINGTON: So what's your point, I'm sorry? I missed your point.

CABEC REP FARBER: Well, I think, and I understand that Jim is working on the revised tailored system that's going to make it less complicated, but I'm not sure that we couldn't come up with a credit system that is so simple that you couldn't just simply apply the credit to any approach. In other words, you get so many watts per square foot of wall, you know, you can't exceed the watts of the display lighting within so many feet of the wall, and that's that.

And you're simply allowed to have that to whatever you come up by any method. And by doing a system that simple, I think you would get around people playing games with the tailored system, so I just wondered if that had been thought of at all.

CEC STAFF PENNINGTON: So do you have a reaction to that?

CONTRACTOR BENYA: I thought a lot about this when I got his comments initially. I'm a little bit concerned about it making it complicated for the inspecting authority again.

CEC STAFF SHIRAKH: He just left.

CONTRACTOR BENYA: Yeah, well, Tom -- I think he'd probably appreciate this, but the notion is that when you do a new calculation, you kind of, particularly with the area category and whole building methods, my personal understanding of these methods has been to say, you know, of all building designs you could conceivably do within reason, regardless of energy use, to allow, you know, kind of the average energy efficiency project or better. And that if you wanted to start moving into the less, quote, unquote, energy efficient area, you may have to justify it.

And that takes you into the tailored method. The tailored method is basically there to allow you to justify extraordinary needs. Ordinary needs should fall within the whole building and area category methods. And I don't think I -- I can't think of a project that had ordinary means that couldn't fall within that and kind of work out. I don't think it should be any harder than that.

You know, that's the great success of Title 24, is that if you don't want to push the envelope, you know, in kind of the wrong direction, then just do it. And so I don't -- I didn't think it was something that was broke, so I don't think it needs to be fixed.

CABEC REP FARBER: Okay. Well, that's fine. I just didn't know whether it had been considered, but I'm glad that you're working on simplifying the tailored method. I think it's just --

CONTRACTOR BENYA: Yeah, I agree with your comments on that. That needs some examination.

CABEC REP FARBER: Yeah, great.

WORKSHOP CHAIR ALCORN: Anything else, Gary?

CABEC REP FARBER: Well, one quick question. Low bay, you didn't propose changes on that; is that because of the type of lighting used? Only high bay was changing? I was just curious about that.

CONTRACTOR BENYA: I think that may have been one where, when I re-ran the calculations -- You have to understand that I redid every model.

CABEC REP FARBER: Right.

CONTRACTOR BENYA: And there may be some places in which I disagreed with the original model, and the results came out saying don't change it.

CABEC REP FARBER: Okay.

CONTRACTOR BENYA: So I would not jump to any conclusions, because if there was a problem with some of the existing models, if I personally felt in doing my analysis that the models were too tight to begin with, then this improvement in technology kind of catches them up.

I think there's always a danger when you try and develop these models of being too fine, too resolved, too detailed, and you create problems with certain facility types, and this process in some respects allows us to make minor corrections like that as we go along.

CABEC REP FARBER: All right. Great, thanks.

WORKSHOP CHAIR ALCORN: All right.

CEC STAFF SHIRAKH: I just have one quick comment.

WORKSHOP CHAIR ALCORN: Sure.

CEC STAFF SHIRAKH: Some of the new area categories we're proposing may turn out to be occupancy type I, according to the Uniform Building Code or the California Building Code. That's the detention, holding cells; even if it is not a prison facility, it's in a courthouse or some other civic facility.

CABEC REP FARBER: And are some convalescent homes I?

CEC STAFF SHIRAKH: Some convalescent

homes, Alzheimer's, and police departments may also turn out to be --

CABEC REP FARBER: So they're exempt.

CEC STAFF SHIRAKH: Well, you know, not by statute, it's by our own choice.

CABEC REP FARBER: So you're saying we may grab some of I?

CEC STAFF PENNINGTON: Well, no, I don't think that's what Mazi is trying to say --

CONTRACTOR ELEY: But I is in the statute, isn't it?

CEC STAFF PENNINGTON: No, it's not.

CONTRACTOR ELEY: Oh, it's not?

CEC STAFF PENNINGTON: No, I mean, this was a decision that the Commission made at the outset --

CONTRACTOR ELEY: Oh, that's right.

CEC STAFF PENNINGTON: -- that other state agencies have authority over these buildings, and we will define it as not within the scope of the Commission standards.

CONTRACTOR ELEY: You're right.

CEC STAFF PENNINGTON: So in order to establish requirements for those types of occupancies, at a bare minimum we would need to coordinate with those other agencies.

And even saying that they're within the scope of our standards would be a severe break with precedent. So I don't think we would do it casually. So I don't know if that's what you were going to say, Mazi --

CEC STAFF SHIRAKH: Yeah, well, that's --

CONTRACTOR BENYA: I apologize for having to present and run, but --

WORKSHOP CHAIR ALCORN: Thank you. Thanks, Jim.

CONTRACTOR BENYA: See you all later.

CONTRACTOR ELEY: I'll talk to you Friday.

CONTRACTOR BENYA: Okay.

CABEC REP FARBER: I have a suggestion on the senior housing, just to clarify it in the title, senior residential care housing. Put the word "care" in there? That might help.

WORKSHOP CHAIR ALCORN: Okay. Do you have any more comments, Gary?

CABEC REP FARBER: I think that's it. Thank you for your time.

WORKSHOP CHAIR ALCORN: Thanks for

coming, Gary.

And are there any other closing comments from anyone before we adjourn?

All right. Thanks for hanging in there for a long afternoon. And, by the way, the next workshop, just for a formal thing, is May 30th. The notice will be posted mid-May.

Thank you.

(Thereupon, the workshop was adjourned at 4:50 p.m.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 30th day of April, 2002.